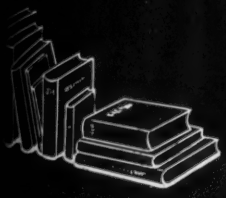
# ABSTRACTS OF NORTH AMERICAN GEOLOGY



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# ABSTRACTS OF NORTH AMERICAN GEOLOGY

## INTRODUCTION

Abstracts of North American Geology contains abstracts of technical papers and books and also citations of maps on the geology of North America including Greenland, the West Indies, as well as the State of Hawaii, Guam, and other island possessions of the United States. Articles of a general nature by North American authors are cited even though published in foreign journals but those by foreign authors are included only if they appear in North American journals. Abstracts are prepared only of material that is believed to be generally available. Ordinarily abstracts are not published of material with small circulation (such as dissertations, open-file reports of memorandums) or of other papers presented orally at meetings.

The Abstracts is an additional reference tool but does not replace the Bibliography of North American Geology, which has been published by the Geological Survey since 1887. Twelve monthly issues of Abstracts of North American Geology are published each year. The Bibliography includes citations and subject index for a calendar year.

The numbers assigned to the abstracts in this publication are for reference in using the index; they are not order numbers. Publications cited here in abstract form are available in most geological libraries or through interlibrary loan.

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A list of journals commonly cited in Abstracts of North American Geology may be obtained by writing to the U.S. Geological Survey, Washington, D. C. 20242. Serial publications cited for the first time are as follows:

[Netherlands] Rijks Geol. Dienst Med.—Mededelingen van de Rijks Geologische Dienst. Harlem, Netherlands.

Quart. Jour. Eng. Geology—The Quarterly Journal of Engineering Geology. Geological Society of London. London, England.

South Carolina Devel. Board Bull.—South Carolina State Development Board Bulletin. Columbia, S. C.

Soviet Geography—Rev. and Translation—Soviet Geography—Review and Translation. American Geographical Society. New York, N. Y.

The abstracts in this issue were prepared by Harold H. Arndt, James W. Clarke, H. Edward Clifton, Georgianna D. Conant, Howard R. Cramer, Katherine A. Friberg, Virginia M. Jussen, Elisabeth S. Loud, Beth M. Madsen, Mildred C. Mead, Willis H. Nelson, Virginia S. Neuschel, D. W. Rankin, M. W. Reynolds, C. L. Sainsbury, Dorothy B. Vitaliano, Holly C. Wagner, and Warren E. Yeend.

# ABSTRACTS

**Abbott, R. Tucker.** *See* Richards, Horace G. 01431

01533 **Abdel-Khalek, M. Lotfi; Khoury, S. G.** The structural history of the Forest-Goode quadrangles, in the Piedmont of Virginia [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 4, Southeastern Sec., p. 1, 1969.

01534 **Acker, Louis L.; Hatcher, Robert D., Jr.** Relationships between topography and structure in northwesternmost South Carolina [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 4, Southeastern Sec., p. 1-2, 1969.

01535 **Adams, John K.** The origin of wavellite and variscite in the Carolina Coastal Plain [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 4, Southeastern Sec., p. 2, 1969.

**Aiello, Paul V.** *See* Meighan, Clement W. 07309

01343 **Aitken, J. D.** Documentation of the sub-Cambrian unconformity, Rocky Mountains main ranges, Alberta: Canadian Jour. Earth Sci., v. 6, no. 2, p. 193-200, illus., table, 1969.

Much of the existing literature on the base of the Cambrian System in the southern Rocky Mountains tends to de-emphasize the importance of the stratigraphic hiatus represented. Although a sub-Cambrian regional unconformity has been reported by several authors, conclusive evidence of the unconformity has not been published. This paper documents profound truncation of Miette Group strata of Windermere age at the base of the Gog Group of Early Cambrian age, and draws attention to several localities at which Precambrian structures are truncated at the base of the Cambrian. The sub-Cambrian unconformity is comparable in style and magnitude to the sub-Devonian unconformity of the same region.-Author's abstract

**Aki, Keiiti.** *See* Tsai, Yi-Ben. 01385

01352 **Alaska Div. Mines and Geology.** Report for the year 1968: College, Alaska, State of Alaska Dept. Nat. Resources, 67 p., illus., tables [1969?].

This review contains a summary of the mining industry and of government activities during 1968; abstracts of field and laboratory reports; special reports; programs and reports of the Division of Mines and Geology; activities of companies, consultants, and miners and prospectors active during the year; and a publications list.-MCM

01236 **Albee, Arden L.; Chodos, Arthur A.** Minor element content of coexistent $Al_2SiO_5$ polymorphs: Am. Jour. Sci., v. 267, no. 3, p. 310-316, illus., table, 1969.

Microprobe analyses were made of coexistent $Al_2SiO_5$ polymorph samples from Idaho (Hietanen, 1956) and Vermont (Woodland, 1963). Only Fe occurs in appreciable amounts. The Fe/Al values differ from sample to sample but have nearly identical ranges in all polymorphs in a given sample. Solid solution of minor elements does not appear to account for the coexistence of the polymorphs in the two areas, and the most likely explanation is probably metastable persistence during a multiphase metamorphism.-Authors' abstract

07252 **Albee, Arden L.** Metamorphic zones in northern Vermont, Chap. 25 *in* Studies of Appalachian geology, northern and marine (Zen, E-an, and others, editors): New York and London, Interscience Publishers, p. 329-341, illus., 1968.

The pelitic rocks of north-central and northwestern Vermont are regionally metamorphosed schistose rocks of the kyanite-sillimanite facies, whereas those of northeastern Vermont are hornfelsic, "regional-contact" metamorphosed rocks of the low pressure, intermediate facies. Mineralogical and textural differences between the western and eastern belts, in conjunction with retrogression of some of the higher grade rocks in the western belt, suggest that the western terrane shows predominantly the effects of an earlier metamorphism associated with formation of the Green Mountain anticlinorium, and that the rocks of the eastern part of the area show predominantly the effects of a later metamorphism associated with the New Hampshire Plutonic Series.-JWC

01299

01536 **Alberts, James; Harriss, Robert C.** Phosphorus balance in the world ocean [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 4, Southeastern Sec., p. 2-3, 1969.

01396 **Alcock, E. D.** The influence of geologic environment on seismic response: Seismol. Soc. America Bull., v. 59, no. 1, p. 245-268, illus., 1969.

01537

A brief review is given of the state-of-the-art and the theory involved in the influence of geology on seismic response. Several field experiments are described which were performed to determine the dynamic amplification of seismic response by alluvium. In the Dry Lake area (saturated alluvium) resonant depths of alluvium were observed at 500 feet and 1400 feet. This is in approximately the harmonic ratio as predicted by theory. In the Hidden Valley area (dry alluvium) the resonant depth of alluvium was observed at 300 feet. The ratio of 500 feet to 300 feet for the two areas is in fair agreement with the ratio of 7000 feet to 5300 feet for the velocities of the alluvium in the two areas as determined by the refraction surveys.-Author's abstract

01233

07169 **Allen, R. H.; Spooner, E. L.** (compilers). Annotated bibliography of BEB and CERC publications: U.S. Army Corps Engineers Coastal Eng. Research Center Misc. Paper 1-68, 141 p., 1968.

The bibliography of Beach Erosion Board publications from 1940 to 1963 and of its successor, Coastal Engineering Research Center publications from 1963 through 1967 contains a summary or abstract for each title. Included is a list of Beach Erosion Control Reports that have been published as House Documents of the U.S. Congress. To aid the user there are indexes of authors, titles, and subjects.-*from* Authors' abstract

01173

01380 **Alterman, Z. S.; Rotenberg, A.** Seismic waves in a quarter plane: Seismol. Soc. America Bull., v. 59, no. 1, p. 347-368, illus., 1969.

The equations for elastic wave propagation are solved by a finite difference scheme for the case of an elastic quarter plane. A point-source emitting a compressional pulse is located along the diagonal inside the quarter plane. Free-surface conditions are assumed on the boundary lines, so that the problem is nonseparable. Complete theoretical seismograms for the horizontal and vertical components of displacement are obtained. The effect of different finite difference formulations for the boundary conditions and the effect of different mesh sizes are studied. Various reflected volume and surface waves are identified, corner-generated surface waves are clearly seen in the seismograms and their particle motion is studied. The amplitude of the pulse observed at the corner is three times the amplitude of the initial pulse.-Authors' abstract

07224

01339 **Althaus, Egon.** Experimental evidence that the reaction of kyanite to form sillimanite is at least bivariant: Am. Jour. Sci., v. 267, no. 3, p. 273-277, illus., tables, 1969.

07174

Mixtures of the sillimanite and kyanite starting materials used in two published investigations were placed side by side at 750°C and $10 \pm 0.5$ kb $P_{water}$ (Althaus, 1967; Richardson and others, 1968). After five days, kyanite in one mixture had nearly disappeared while in the other sillimanite had nearly disappeared. The differences must be attributed to the starting materials. The two kyanites were essentially identical, but the sillimanites differ appreciably in $Fe_2O_3$-content, and this is thought to be the most likely cause of the divergent results for the two investigations.-*from* Author's abstract

07331

01299 **Anderson, Duwayne M.; Reynolds, Robert C.; Brown, Jerry.** Bentonite debris flows in northern Alaska: Science, v. 164, no. 3876, p. 173-174, illus., 1969.

A new geomorphic feature, bentonite debris flow channels, has been identified near Umiat, Alaska. These flows form when bentonite-rich Cretaceous shales are exposed to surface water on slopes of 5° to 30°. The characteristic landform developed is a U-shaped channel 1 to 2 m deep and from 8 to 10 m wide. The channel shows a fluted floor and walls and is commonly flanked by a levee. The flow material is apparently derived from the entire surface of the head portions of associated gullies. When this surface layer hydrates during snowmelt and runoff or during prolonged rain, the bentonite imbibes water and swells to a point at which its viscosity is lowered sufficiently to initiate creep or viscous flow.-*from* Authors' abstract

**Anderson, Franz E.** *See* Hess, Frederick R. 01479

01537 **Anderson, Franz E.; Gaudette, Henri E.; Hatfield, Edward B.** Factors affecting the composition of estuarine particulate matter [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 4, Southeastern Sec., p. 3, 1969.

01233 **Anderson, P. A. M.; Kleppa, O. J.** The thermochemistry of the kyanite-sillimanite equilibrium: Am. Jour. Sci., v. 267, no. 3, p. 285-299, illus., 1969.

The enthalpies of solution of kyanite and sillimanite in a lead borate solvent ($2PbO \times B_2O_3$) have been determined calorimetrically at 701 ± 2°C. From the observed values for one sample of kyanite and two different samples of sillimanite the enthalpies of transformation kyanite = sillimanite were redetermined to be 1.42 ± 0.18 kcal/g.f.w. and 1.52 ± 0.23 kcal/g.f.w., respectively at 701°C. From these values we have recalculated the P-T equilibrium curves for the kyanite-sillimanite equilibrium for pressures below 12 kb. Within the indicated errors both the calculated curves are consistent with recent experimental determinations.-Authors' abstract

01173 **Anderson, R. Ernest.** Notes on the geology and paleohydrology of the Boulder City pluton, southern Nevada, *in* Geological Survey research 1969, Chap. B: U.S. Geol. Survey Prof. Paper 650-B, p. B35-B40, illus., 1969.

Boulder City pluton, a composite granitoid Tertiary intrusive exposed for more than 10 sq mi in the northern Eldorado Mts., Nevada-Ariz., is bounded mostly by faults. On the basis of stratigraphic and isotopic data, the pluton has an age ranging from Eocene(?) to Miocene(?). Downcutting by the Colorado River has exposed the pluton to a depth of about 1,800 feet below a horizontal red-brown cliff-forming zone (ancient water table), and thus reveals that the pluton is probably not a laccolith or sill-like mass as previously suggested.-*from* Author's abstract

07224 **Anderson, Roy.** Seattle freeway, *in* Assoc. Eng. Geologists, 1968 Natl. Mtg., Seattle, Wash., Guidebook to field trips: [Sacramento, Calif.] Assoc. Eng. Geologists, p. 77-78, 1968.

The drumloidal hills bordering Puget Sound have clay cores which are covered by a mantle of till and outwash gravel of variable thickness. The clay was compressed by glacial ice 4,000 feet thick. These locked-in stresses created vertical and horizontal rebound adjustments within the clay upon the removal of the overburden. Ground water then introduced into the rebound cracks and fissures resulted in a massive slide potential. Vertical pile walls and horizontal drains are used to retain the clay from sliding.-HRC

07174 **Andrews, J. T.; Barry, R. G.** Remarks on the retreat of the North American ice sheet [discussion of paper by N. R. Malkin, 1966]: Soviet Geography-Rev. and Translation, v. 9, no. 10, p. 882-885, 1968; originally published in Russian, 1967.

This discussion was published originally in Vses. Geog. Obshch. Izv., v. 99, no. 3, p. 230-231, 1967. *See* Abstracts of North American Geology for December 1967.

07331 **Anhaeusser, C. R.; Mason, R.; Viljoen, M. J.; Viljoen, R. P.** A reappraisal of some aspects of Precambrian shield geology: Witwatersrand Univ. Econ. Geology Research Unit Inf. Circ. 49, 30 p., illus., tables, 1968.

Noting misconceptions regarding ancient crystalline shields, an attempt is made to clarify some ideas on their geology. Recent studies in South Africa reveal a well-defined pattern of evolution. "Earliest Precambrian" are the stable cratonic nuclei incorporating greenstone belts. Different in character and younger than the cratons they surround are "Precambrian Mobile Belts"-large, linear zones of granitized gneiss. Fundamental elements of the geology of the greenstone belts and pattern of relationship with surrounding granitic terrain are repeated in other shields of the world. However, ultramafic rocks are not always encountered, particularly in Canada where andesitic volcanics seem prominent. Worldwide uniformity of the stratigraphy, structure, metamorphism, mineralization, associated granites, and geotectonic setting of the greenstone belts is stressed.-GDC

01250 **Armstrong, Richard L.; Ekren, E. B.; McKee, Edwin H.; Noble, Donald C.** Space-time relations of Cenozoic silicic volcanism in the Great Basin of the western United States: Am. Jour. Sci., v. 267, no. 4, p. 478-490, illus., 1969.

Physical stratigraphy and more than 250 K-Ar dates demonstrate a definite space-time pattern of Cenozoic silicic volcanism in the Great Basin. Known vent areas of voluminous ash flows and approximate source areas for sheets provide the control points. Volcanism began about 40 m.y. ago and volcanic rocks are most abundant in east-central Nevada. The locus of activity then shifted outward toward the margins of the Great Basin. Silicic activity ceased in east-central Nevada about 25 m.y. ago and by 20 m.y. ago was restricted to the margins of the basin. Intensity has decreased progressively for the last 10 m.y. East-central Nevada is less seismic and possibly has a thicker crust than the rest of the basin. The outward migration of volcanism may have been the result of convection within the mantle with a rising current centered on the east-central part of the Great Basin.-*from* Authors' abstract

07302 **Arnold, Chester A.** Current trends in paleobotany: Earth-Sci. Rev., v. 4, no. 4, p. 283-309, illus., 1968.

Precambrian rocks now are known to have a variety of microfossils, and compounds believed to be decomposition of chlorophyll are found in rocks three billion years old. New ideas have developed concerning the morphology and relationships of some of the very old vascular plants. Seeds are recognized from the Upper Devonian. Decreased coal mining has decreased the study of compressions, but outstanding progress has been made in study of plants in coal-balls. Studies of the *Glossopteris* flora in Antarctica suggest that continental drift is the only hypothesis that explains the positions of Gondwanaland fragments. Studies of the inflorescences of *Cycadeoidea* have revealed new features requiring some of the old interpretations to be abandoned, and the occurrence of angiosperm leaves in the Lower Cretaceous of Greenland is questioned.-HRC

07212 **Association Eng. Geologists; McKee, Bates; Coombs, Howard.** (editors): Guidebook to field trips, 1968 Natl. Mtg., Seattle, Wash.: [Sacramento, Calif.] Assoc. Eng. Geologists, 107 p., illus., 1968.

This guidebook contains sixteen papers (cited separately) dealing with different engineering projects in Seattle and vicinity, Washington. There is no road log published. There are five papers dealing with the general geology of the Cascade Mountains, four dealing with landslides, six with dam sites, one with irrigation, and one with highways.-HRC

07149 **Athaullah, Muhammad.** Prediction of bed forms in erodible channels [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 29, no. 3, p. 1013B, 1968.

01214 **Aumento, F.; Loncarevic, B. D.** The Mid-Atlantic Ridge near 45° N.-[Pt.] 3, Bald Mountain: Canadian Jour. Earth Sci., v. 6, no. 1, p. 11-23, illus., tables, 1969.

Metamorphosed and metasomatized basalts, and unmetamorphosed equivalents, were recovered from the steep slopes of Bald Mountain, a north-south elongated seamount lying 60 km west of the Median Rift Valley at 45° N. Block faulting and uplift of the seamount, together with the removal by submarine erosion of extrusive rocks capping the seamount, have resulted in the exposure of the more deep-seated

metamorphosed horizons along the fault scarps. The block-faulted nature of Bald Mountain, indicative of brittle fracturing of the upper crustal layers of the Mid-Atlantic Ridge, may be a result of the low ocean floor spreading rates implied from age determinations and magnetic anomaly patterns at 45° N.-Authors' abstract

07151 **Avedissian, Yeghishe Murad.** Correlation of creep of rock with its dynamic properties [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 29, no. 3, p. 1062B, 1968.

**Avrett, J. R.** *See* Turner, J. D. 07141

**Avrett, J. R.** *See* Newton, J. G. 07269

**Axford, W. I.** *See* Johnson, H. E. 01310

**Baadsgaard, H.** *See* Condie, Kent C. 01295

**Bachinski, D.** *See* Kanehira, K. 07239

07231 **Baer, A. J.** Model of evolution of the Bella Coola-Ocean Falls region, Coast Mountains, British Columbia: Canadian Jour. Earth Sci., v. 5, no. 6, p. 1429-1441, illus., tables, 1968.

The age of most of the granitic and metavolcanic rocks is unknown. The area has been involved in at least two orogenic cycles. The oldest known supracrustal rocks (upper Paleozoic?) have been metamorphosed to gneisses, deformed along northeasterly trends, and intruded by granite, probably early in the Mesozoic. These underlie Mesozoic sediments and volcanics. The basement and its Mesozoic cover were metamorphosed and deformed along northwesterly trends in the early Tertiary. In the late Tertiary (Pliocene?) post-kinematic granites were emplaced and basalts were extruded for a period extending into postglacial times. This model is possibly applicable to all of the Coast Mountains in Canada.-*from* Author's abstract

**Bailey, B. V.** *See* Black, C. D. G. 07175

01268 **Bailey, D. K.** The stability of acmite in the presence of $H_2O$: Am. Jour. Sci., v. 267-A (Schairer Volume), p. 1-16, illus., tables, 1969.

Acmite is stable in the partial pressure range of oxygen provided by hematite-magnetite and quartz-fayalite-magnetite buffers at 2-5 kb and in presence of excess $H_2O$. Acmite melting is very sensitive to oxidation but not so to total pressure in the 2-5 kb range. Acmite is unstable in excess water between 1 and 4 kb when oxygen partial pressure is controlled by wustite-magnetite and iron-wustite. Examples in rocks of fluctuating crystallization of aegerine and arfvedsonite may have been controlled by fluctuating oxidation conditions in the magma. Partial melting of peralkaline rocks could be achieved at constant temperatures and pressure merely by reduction of the partial pressure of oxygen in the coexisting vapor phase.-*from* Author's abstract

07285 **Baird, D. E.** Evaluation of Middle East reservoirs with complex lithology, *in* SPWLA Logging Symposium, 9th Ann., New Orleans, La., 1968, Trans.: Houston, Tex., Soc. Prof. Well Log Analysts, p. U1-U27, illus., tables, 1968.

This paper is concerned with the practical interpretation problems posed by the carbonate reservoirs of the Middle East. The matrix may be a mixture of limestone, dolomite and anhydrite. The porosities are sufficiently high to cause the porosity logs to be affected by the presence of oil in the formation around the borehole, and the apparent grain densities, derived from Neutron-Formation Density cross-plots, to be too low. As will be shown a correct solution, in terms of porosity and matrix density, can be obtained with an adequate combination of measurements.-Author's abstract

01321 **Baker, D. W.; Wenk, H. R.; Christie, J. M.** X-ray analysis of preferred orientation in fine-grained quartz aggregates: Jour. Geology, v. 77, no. 2, p. 144-172, illus., tables, 1969.

The preferred orientation of quartz in specimens of experimentally deformed and recrystallized flint was determined with a Norelco pole figure goniometer modified for examining restricted areas of flat specimens by both reflection and transmission. Scans in the two modes were combined to yield complete pole figures. Preferred orientations are axially symmetric and are given by intensity profiles extending 0°-90° from the symmetry axis. Profiles for as many as fifteen diffraction peaks from individual specimens are subjected to spherical harmonic analysis to determine preferred orientation (crystallite distribution function), which is represented concisely in the form of an inverse pole figure. From the inverse pole figure the preferred orientation of any crystallographic direction may be generated. Earlier work applying these methods to polymers and metals is reviewed.-*from* Authors' abstract

**Baker, James H.** *See* Parker, Robert H. 01417

**Baker, N. M.** *See* Randolph, J. R. 01302

07164 **Baladi, George Youssef.** Distribution of stresses and displacements within and under long elastic and viscoelastic embankments [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 29, no. 3, p. 994B-995B, 1968.

01287 **Bandy, O. L.; Morin, R. W.; Wright, R. C.** Definition of *Catapsydrax stainforthi* Zone in the Saucesian Stage, California: Nature, v. 222, no. 5192, p. 468-469, illus., 1969.

The discovery of the association of planktonic species typical of the *Catapsydrax stainforthi* Zone of the tropics in the upper part of the lower Saucesian Stage of Reliz Canyon, Calif., supports the correlation of this important tropical planktonic zone with part of the Saucesian Stage of Kleinpell (1938)-a significant advance in correlating the California lower Miocene with the lower Miocene tropical zones of Bolli (1957) and Banner and Blow (1965). A restudy is needed for other postulated correlations of tropical and California stages.-DBV

01296 **Banks, Philip O.; Rebello, Dennis P.** Zircon age of a Precambrian rhyolite, northeastern Wisconsin: Geol. Soc. America Bull., v. 80, no. 5, p. 907-910, illus., tables, 1969.

U-Pb isotopic analyses of three cogenetic zircon fractions from a Precambrian rhyolite of the Quinnesec Formation in northeastern Wisconsin yielded a concordia intercept age of 1905 (+30 to−10) m.y. Thus, at least part of the Quinnesec Formation is late or post-Animikie in age and is not correlative with the pre-Animikie complexes of Michigan, as has been previously believed.-Authors' abstract

01319 **Banks, Philip O.; Cain, J. Allen.** Zircon ages of Precambrian granitic rocks, northeastern Wisconsin: Jour. Geology, v. 77, no. 2, p. 208-220, illus., tables, 1969.

Zircon of the Amberg Granite and of the Newingham Granodiorite show a U-Pb concordia intercept age of 1860 ± 15 m.y., of the Dunbar Gneiss 1880 ± 15 m.y., and of the Hoskin Lake Granite 1890 ± 15 m.y., all within the time range of the Penokean orogeny. Slight differences of slopes and intercepts argue against any single mechanism for the observed isotopic disturbance patterns.-*from* Authors' abstract

01381 **Barazangi, Muawia; Dorman, James.** World seismicity maps compiled from ESSA, Coast and Geodetic Survey, epicenter data, 1961-1967: Seismol. Soc. America Bull., v. 59, no. 1, p. 369-380, illus., 1969.

Seismicity maps are published from the preliminary determinations of hypocenters of the USCGS, Environmental Science Services Adminstration, Department of Commerce. The seismicity covers the interval Januay 1, 1961 through December 31, 1967. Two large plates accompany the paper. Plate 1 contains a plot of all epicenters; Plate 2 shows a plot of all events deeper than 100 km.-Authors' abstract

**Barry, R. G.** *See* Andrews, J. T. 07174

**Barton, Jackson M., Jr.** *See* Doig, Ronald. 07240

01252 **Bass, Manuel N.; Ferrara, Giorgio.** Age of adularia and metamorphism, Ouachita Mountains, Arkansas: Am. Jour. Sci., v. 267, no. 4, p. 491-498, tables, 1969.

Adularias from quartz veins give isotopic ages which bracket crystallization between 287 and 214 m.y. ago. A Middle Pennsylvanian age is excluded. Isotopic, stratigraphic, and structural data suggest deposition in Late Pennsylvanian or Early Permian and persistence of mild deformation and elevated temperatures related to low-grade regional metamorphism into and possibly somewhat after Middle Permian. The metamorphism may coincide with the 250 m.y. heating event in the southern Appalachians. Feldspar data suggest continuous Ar diffusional loss activated by very slow Al-Si ordering toward the stable structural state of maximum microcline. Feldspars in intermediate structural states are more prone to such ordering and give lower ages.-*from* Authors' abstract

01392 **Batterman, B. W.; Strock, H.** The determination of structure factors by means of intensity measurements from large single crystals, *in* Accurate determination of X-ray intensities and structure factors, Internat. Mtg., Cambridge, England, 1968: Acta Cryst., v. A25, pt. 1, p. 109-110, illus., 1969.

Errors are considered which arise when structure factors are measured on perfect crystals. These include long wavelength harmonics in the incident radiation, TDS, and absorption effects.-Authors' abstract

01538 **Bauerlein, Henry J.** Geology of the Millers Cove area, Virginia [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 4, Southeastern Sec., p. 3-4, 1969.

01539 **Beerbower, James R.** Ecologic factors in skeletal evolution in the early Paleozoic [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 4, Southeastern Sec., p. 4, 1969.

**Bell, P. M.** *See* Richardson, S. W. 01338

01277 **Bell, Peter M.; Davis, Brian T. C.** Melting relations in the system jadeite-diopside at 30 and 40 kilobars: Am. Jour. Sci., v. 267-A (Schairer Volume), p. 17-32, illus., tables, 1969.

At 30 and 40 kb jadeite-diopside is a binary system. A melting interval extends for the full compositional range and is analogous to that observed in plagioclase feldspars. This system leads to petrogeny's residual system, and the fractionation behavior follows Bowen's trend except that an extremely narrow melting interval may produce only limited concentrations of jadeite constituents in high-pressure magmas. Relationships in the subsolidus region can be deduced in a qualitative way from volumetric data measured on solid solutions along the binary join. Calculations of a regular solution model suggest that the addition of diopside to jadeite will not have a great effect on the breakdown of jadeite to albite + nepheline.-Authors' abstract

07140 **Belt, Edward S.** Post-Acadian rifts and related facies, eastern Canada, Chap. 7 *in* Studies of Appalachian geology, northern and marine (Zen, E-an, and others, editors): New York and London, Interscience Publishers, p. 95-113, illus., table, 1968.

Carboniferous deposits of eastern Canada are thick and highly deformed in narrow regions of southeastern New Brunswick, northern Nova Scotia, and central Newfoundland. The region of thick strata, called the Fundy basin, is interpreted as a complex rift valley bounded by high-angle faults or sharp downflexures and surrounded by relatively stable platforms. The Carboniferous rocks immediately adjacent to the pre-Carboniferous basement rocks are fanglomerates that locally contain boulders several meters in size. Within a distance of a few kilometers, coarse sandstone grades toward the center of the local depositional basins into fine-grained sandstone and then into shale. The direction of dip of major longitudinal faults can be observed only in a few localities in eastern Canada; where known they dip toward the rift basin. The northeast-trending fault systems were probably shear directions, and east-west systems were tensional or compressional.-JWC

01406 **Bentley, Robert D.; Deininger, Robert W.** Granitic plutons in the Alabama Piedmont [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 4, Southeastern Sec., p. 4-5, 1969.

01523 **Bentley, Robert D.** Strike slip faults in Lee County, Alabama [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 4, Southeastern Sec., p. 5, 1969.

**Berg, Eduard.** *See* Gedney, Larry. 01400

**Berg, Joseph W., Jr.** *See* Long, Leland Timothy. 01388

**Bernas, R.** *See* Yiou, F. 01311

**Berry, Ronald F.** *See* Parker, Robert H. 01417

07180 **Berry, William B. N.** Ordovician paleogeography of New England and adjacent areas based on graptolites, Chap. 2 *in* Studies of Appalachian geology, northern and marine (Zen, E-an, and others, editors): New York and London, Interscience Publishers, p. 23-34, illus., table, 1968.

Fifteen Ordovician graptolite zones provide a reference net for correlation of time and time-stratigraphic units in New England. Four northeast-trending belts are recognized: Limestone, Shale, Volcanoes and Islands, and Aroostook-Matapedia. The sediments of the Shale Belt were probably deposited in deeper water than those of the Limestone Belt, and the gradation between them was probably marked by a steep sea floor. The quartz and feldspar content of many of the sediments of the Volcanoes and Islands Belt as well as the apparent shallow-water origin of some of these sediments suggest the presence of non-volcanic as well as volcanic islands. Folding, uplift, and erosion took place during the early Middle Ordovician, and the Taconic allochthon was emplaced as part of the tectonic activity during zone 13 through 15 time.-JWC

01524 **Beyer, Paul J.** Chemical alteration of slate belt xenoliths in a granodioritic stock [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 4, Southeastern Sec., p. 5-6, 1969.

**Biggar, G. M.** *See* O'Hara, M. J. 01280

01525 **Biggs, Robert B.; Flemer, David A.** The flux of particulate carbon in an estuary [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 4, Southeastern Sec., p. 6, 1969.

07342 **Bik, M. J. J.** Morphoclimatic observations on prairie mounds [with German and French summ.]: Zeitschr. Geomorphologie, new ser., v. 12, no. 4, p. 409-469, illus., tables, 1968.

By detailed sedimentary analysis of two prairie mounds in the Foremost-Cypress Hills till area, southern Alberta, their depressed and rim-breached features appear modified by morphogenetic events of the last 10,000 years. "Bedded niveo-aeolian deposits are assigned to the Earlier Dryas Period," apparently periglacial, and cessation of this deposition in the central fill identifies the semi-arid Allerod Period. Upper niveo-aeolian deposits, placed in the Younger Dryas Period, post-date the Allerod. Slope stability and soil formation followed the second periglacial phase and ended with a thin cover of Mazama? volcanic ash; slope instability, under conditions more arid than now, produced thick colluvium, Xerothermal (or Altithermal) by analogy with deposits in Waterton Park. The characteristic stoney cover may also be Xerothermal.-GDC

01526 **Bingham, Thomas R.** Vertical distribution of foraminiferal tests in estuarine sediments [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 4, Southeastern Sec., p. 6-7, 1969.

07259 **Birch, Francis; Roy, Robert F.; Decker, Edward R.** Heat flow and thermal history in New England and New York, Chap. 33 *in* Studies of Appalachian geology, northern and marine (Zen, E-an, and others, editors): New York and London, Interscience Publishers, p. 437-451, illus., tables, 1968.

Heat flow data from 22 boreholes in New England and New York are tabulated, and the thermal history since Early Devonian time is traced in a schematic fashion. The rise of temperature during deposition is treated mathematically, followed by a similar treatment for the fall in temperature during regional erosion. A close correlation is found between heat flow and radioactive heat generation in the near-surface bedrock.-JWC

01527 **Bird, Samuel O.** Molluscan communities in the Newport River Estuary, North Carolina [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 4, Southeastern Sec., p. 7, 1969.

07182 **Bittinger, Morton Wayne.** Simulation and analysis of stream-aquifer systems [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 29, no. 4, p. 1345B, 1968.

07175 **Black, C. D. G.; Bailey, B. V.** Investigation of the Barbecue copper prospect: Jamaica Geol. Survey Econ. Geology Rept. 2 (Pub. 103), 11 p., illus., tables, geol. map, 1968.

A geochemical survey of stream sediments in the Yallahs River drainage (Sinclair, 1967) located several areas showing anomalous values of copper and nickel; the most promising was in the Barbecue Valley near Bloxburgh, where a copper anomaly is associated with the base of the extrusive Newcastle Porphyry in contact with the lower Eocene sedimentary Wagwater Formation. A geochemical soil survey of the Barbecue prospect showed a significant anomaly, >100 ppm cold extractable copper, over an area of about 100,000 sq yd; channel sampling and limited corehole exploration confirmed presence of copper in the bedrock at a tenor of 0.6 to over 1 percent in shear zones, but as low as 0.1 percent in unsheared sediments. No further drilling should be done until the area is surveyed by Induced Polarization, which would indicate vertical extent of sulfide mineralization.-VMJ

**Blackburn, W. H.** *See* Dennen, W. H. 01521

01528 **Blackburn, W. H.; Dennen, W. H.** The interaction of mechanics and chemistry in the formation and destruction of zoning in garnets [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 4, Southeastern Sec., p. 8, 1969.

**Blackwelder, B. W.** *See* Macintyre, I. G. 01462

**Blanton, Carol J.** *See* Blanton, W. George. 01529

01529 **Blanton, W. George; Blanton, Carol J.; Rich, Jean.** Monitoring changes in populations of bacteria in surface sediments from two narrow river estuaries and a marine bay [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 4, Southeastern Sec., p. 8-9, 1969.

**Block, S.** *See* Dziewonski, A. 01384

01530 **Bloss, F. Donald.** Indexing powder diagrams of isometric crystals [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 4, Southeastern Sec., p. 9, table, 1969.

01390 **Blume, John A.** Spectral response to ground displacement at Hattiesburg resulting from nuclear event Salmon: Seismol. Soc. America Bull., v. 59, no. 1, p. 229-244, illus., tables, 1969.

Spectral response is developed from principal portions of a record of ground displacement in Hatticsburg, Mississippi, resulting from the Salmon event, Project DRIBBLE, an underground nuclear explosion near Baxterville, Mississippi in October 1964. No acceleration records are available for Hattiesburg. As a part of the

study it was found that peak response in the important short-period range could be reasonably estimated using as little as one second of selected motion from the entire record, and that a simple stochastic model of this key portion of the ground motion essentially duplicated the peak response.-Author's abstract

**Boettcher, A. L.** *See* Wyllie, P. J. 01266

01531 **Bollinger, G. A.** Seismic studies of the Narrows, Virginia earthquake of March 8, 1968 [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 4, Southeastern Sec., p. 9-10, 1969.

07267 **Bolyard, Dudley W.; Chronic, John; Requist, Norris N.; Wolf, Robert C.; Loucks, Gerald G.** Second day's road log-Study of Paleozoic and Mesozoic section along Front Range from west of Pueblo, through Colorado Springs area and north through Palmer Lake, Perry Park and ending at Castle Rock, *in* Guidebook issue, southeastern Colorado: Mtn. Geologist, v. 5, no. 3, p. 154, 165-177, illus., 1968.

This is the second of a two-day field conference of the Rocky Mountain Association of Geologists, held in conjunction with the 1968 Symposium, Petroleum potential of southeast Colorado. Note is made with brief descriptions of geology to be seen along the 153-mile route, which includes four stops to study exposures near Cave of the Winds and in Williams Canyon, Garden of the Gods, and Cove Creek water gap.-GDC

01532 **Bond, T.; Chappel, D.; Colquhoun, D. J.** The continental submerged cycle of sedimentation through examination of the Santee Sangamon submergence [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 4, Southeastern Sec., p. 10, 1969.

01360 **Boore, David M.; Toksöz, M. Nefi.** Rayleigh wave particle motion and crustal structure: Seismol. Soc. America Bull., v. 59, no. 1, p. 331-346, illus., tables, 1969.

A feasibility study was made concerning use of the ellipticity of the Rayleigh wave particle motion for determining Earth structures. It was found that ellipticity and phase velocity are about equally sensitive to structural perturbations, but that near-surface low-velocity sedimentary layers influence ellipticity much more strongly than phase velocity. Anelasticity has a minor effect on ellipticity, whereas the presence of interfering waves can have a significant influence. A test of the independence between ellipticity and phase velocity indicated that ellipticity does contribute independent information, and thus provides an additional constraint toward uniqueness. Using data from LASA, both ellipticity and Rayleigh- and Love-wave phase velocities were measured and results interpreted in terms of crustal structure.-*from* Authors' abstract

01288 **Borchert, Hermann.** Principles of oceanic salt deposition and metamorphism: Geol. Soc. America Bull., v. 80, no. 5, p. 821-864, illus., tables, 1969.

Primary oceanic salt deposits are the result of evaporation of epicontinental sea basins, with restricted drainage, in the foreland or backland of strongly folded and faulted geosynclinal areas. Succession of the primary salts precipitated is controlled by dynamic-polythermal conditions within the basin and the amount of each by the saline phase rule. Later retrograde metamorphism by dilute solutions, of various possible origins but primarily resulting from the change of gypsum to anhydrite, diagenetically changes the mineralogy of the salts, forming potassium-magnesium-sodium sulfate minerals.-BMM

07185 **Bothol, Joseph Moses.** Characteristic analysis of base metal mining districts in the continental United States [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 29, no. 4, p. 1401B, 1968.

**Bottino, Michael L.** *See* Fullagar, Paul D. 01492

**Boucot, A. J.** *See* Pavlides, Louis. 07138

07139 **Boucot, A. J.** Silurian and Devonian of the northern Appalachians, Chap. 6 *in* Studies of Appalachian geology, northern and marine (Zen, E-an, and others, editors): New York and London, Interscience Publishers, p. 83-94, illus., tables, 1968.

The Silurian rocks of the northern Appalachians are disposed in northeast-trending belts as follows: Carbonate rocks of the platform grade to the southeast into a nonmarine sandstone belt, which was bordered by a major land mass, the so-called Appalachia. Marine clastics comprise the area to the southeast of the ancient landmass, except for a narrow strip of carbonates in the Aroostook-Metapedia anticlinorium region. A second landmass further to the southeast later became the site of intensive volcanism. The next terrane on the southeast, the Arisaig belt, consists of terrigenous deposits, and this belt grades to the southeast into non-marine Medina-type sediments of the Annapolis Valley. The Early Devonian lithofacies distributions are similar to those of the Silurian except that no landmasses are indicated.-JWC

**Boucot, Arthur J.** *See* Dennison, John M. 01522

01276 **Boyd, F. R.** Electron-probe study of diopside inclusions from kimberlite: Am. Jour. Sci., v. 267-A (Schairer Volume), p. 50-69, illus., tables, 1969.

These diopsides show a wide range of solid solution toward enstatite, but the distribution of their Ca/(Ca+ Mg) ratios is unexpectedly and asymmetrically bimodal. Comparisons with synthetic standards suggest that the bulk of the kimberlite diopsides have equilibrated at temperatures of the order of 950° to 1000°C whereas the two subcalcic specimens have equilibrated in excess of 1300°C. Studies of the Al, Fe, and Cr oxides suggest that these diopsides may have approached equilibrium more closely with enstatite than with garnet or spinel. The diopside inclusion from a diamond crystal differs from the other examples in having very low $Al_2O_3$ and $Cr_2O_3$ and very high Fe and Mn.-Author's abstract

**Brace, William F.** *See* Byerlee, James D. 01290

**Bradley, W. C.** *See* Eggler, D. H. 01254

01368 **Brady, B. T.** The nonlinear mechanical behavior of brittle rock-Pt. 1, Stress-strain behavior during regions I and II: Internat. Jour. Rock Mechanics and Mining Sci., v. 6, no. 2, p. 211-225, illus., 1969.

The results of a theoretical study describing the loading and unloading stress-strain behavior during regions I and II of homogeneous brittle rock materials displaying a tight pore structure are presented. It is assumed that rock can be modeled by an elastic, isotropic continuum containing a large number of ellipsoidal cracks which are collectively characterized by a distribution function $P(c,\beta,\phi$ ($c$ = crack half-length, $\beta$ = inclination of major axis to direction of maximum principal stress, and $\phi$ = angle between projected crack normal and the $s_2$ axis). Crack interaction effects are neglected.-*from* Author's abstract

**Breuninger, Ray H.** *See* O'Connor, Michael P. 01416

**Brezny, B.** *See* Woermann, E. 01271

**Bricker, Owen P.** *See* Wood, James. 01565

01366 **Briggs, Reginald P.** Changes in stratigraphic nomenclature in the Cretaceous System, east-central Puerto Rico: U.S. Geol. Survey Bull. 1274-0, p. 01-031, illus., 1969.

The system of informal stratigraphic nomenclature used previously for part of the Cretaceous section in east-central Puerto Rico is replaced by a formal nomenclature. The lower part of the Lower Cretaceous Series is not treated. Formal names established include the Lower Cretaceous Torrecilla Breccia with Aguas Buenas Limestone Member assigned to the base and the Barros Tuff Member to the top; Lower Cretaceous Barrancas Limestone Member of the Lower and Upper

Cretaceous Magueyes Formation, Río Orocovis Group; the Río Bauta Member as base of the Upper Cretaceous Pozas Formation which now also includes the Botijas Limestone and Reves Members; and the Toyosa Member as top of the Upper Cretaceous Maravillas Formation.-VSN

07306 **Briscoe, A. J.** Glaciers: Science, v. 162, no. 3852, p. 480-481, 1968.

This is a brief report on a conference held in Banff, Alberta, on June 6-8, 1968, at which particular emphasis was placed on the possible geologic effects of surging glaciers, now and in the past. The Steele glacier in the southwestern Yukon, one of the better known surging glaciers, was the subject of several papers. The possibility of glacial surges at the margins of continental glaciers is of great importance to Pleistocene geologists, because interpretations of glacial history are now based on the assumption that the ice fronts were stable for relatively long time spans in areas of prominent recessional moraines, and that advances along the margins of different lobes were synchronous. Certain observations on recent glaciers suggest that these assumptions are not necessarily valid.-DBV

01407 **Brogden, W. B.; Kator, I. H.; Miget, R. J.; Warnke, D. A.** Trend hypersurfaces as an aid in the interpretation of oceanographic data [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 4, Southeastern Sec., p. 10-11, 1969.

**Bromery, R. W.** *See* Kane, M. F. 07258

**Bromery, Randolph W.** *See* Griscom, Andrew. 07207

01220 **Broscoe, A. J.; Thomson, S.** Observations on an alpine mudflow, Steele Creek, Yukon: Canadian Jour. Earth Sci., v. 6, no. 2, p. 219-229, illus., tables, 1969.

Alpine mudflows occurred above Steele Creek, St. Elias Range, after a rainfall of 2.19 inches in 36 hours. One flow emerged in pulses from a notch at the upper margin of a terrace surface and formed fronts 6 to 8 feet high. The fronts broke and the mud flowed across a fan and through erosional notches to the valley floor. Maps show the topographic details. The stream-deposited coarse bed load on the fan on the upper terrace then cascaded down to the notch and undercutting of the notch caused periodic collapse of the moraine which formed temporary dams, impounding lakes. Particles in the mudflows range from colloids to boulders 13 feet across; pebbles were 70 percent local lava and 18 percent moraine. Rain and runoff took away the fines and left lag deposits similar to alluvial gravels. Botanical evidence suggests that the flows occur in decades.-HRC

01511 **Brown, Bahngrell W.** An oxygen differentiation index [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 4, Southeastern Sec., p. 11, 1969.

01362 **Brown, C. Ervin.** New talc deposit in St. Lawrence County, New York: U.S. Geol. Survey Bull. 1272-D, p. D1-D13, illus., table, geol. map, 1969.

Rock similar to that mined for talc near Fowler, N.Y., since 1880, has been mapped at a new locality in DeKalb Township. It is poorly exposed, is about 100 feet thick at one outcrop, consists of Precambrian schists having various proportions of talc, tremolite, and anthophyllite, and is part of a metasedimentary sequence of the Grenville Series. The talc-bearing rock is in a doubly plunging syncline that trends N. 30° E., its map pattern an isosceles triangle having a base of 3,000 to 4,000 feet near the DeKalb-Gouverneur town line and an apex 3.5 miles to the northeast, near the confluence of Beaver Creek and its South Branch. The talc zone feathers out to the east at the upturned edge of the syncline; the west edge is cut off by a gneissic granite body in the southern part of the area. The synclinal structure plunges less than 20°; the deepest talc zone is probably not more than 1,500 feet below the surface.-GDC

01512 **Brown, G. E.; Gibbs, G. V.; Ribbe, P. H.** The role of d-p$\pi$ bonding in minerals containing $SiO_4^{4-}$, $AlO_4^{5-}$ and $MgO_4^{6-}$ tetrahedral ions [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 4, Southeastern Sec., p. 11-12, 1969.

**Brown, Jerry.** *See* Anderson, Duwayne M. 01299

01292 **Bukhari, S. A.; VandenBerg, A.; Lennox, D. H.** Iterative analysis-Bounded leaky artesian aquifer: Am. Soc. Civil Engineers Proc., v. 95, paper 6431, Jour. Irrigation and Drainage Div., no. IR 1, p. 1-14, illus., tables, 1969.

Application of the leaky artesian well function to analysis of aquifer-test data may be difficult if boundaries are close enough to obscure effects of leakage. If boundary locations can be established, and if transmissibility and storage coefficient can be determined from early drawdown data, the leakage factor, *B*, may be determined by iterative adjustment of an initial rough estimate until observed and calculated drawdowns match within some specified range of accuracy. An algorithm for iterative adjustment is developed and a method of improving its efficiency discussed. Formulas are presented for generalized image-well positions for a strip aquifer and all results combined and applied to digital-computer analysis of drawdown data for a buried valley aquifer near Stettler, Alberta.-*from* Authors' abstract

01377 **Bur, T. R.; McWilliams, J. R.; Hjelmstad, K. E.** Velocity errors in cemented specimens: Internat. Jour. Rock Mechanics and Mining Sci., v. 6, no. 2, p. 203-209, illus., tables, 1969.

When determining sonic velocities of rock by the resonance method, specimens must be of sufficient length to keep resonant frequencies within the upper frequency limit of the instrument. The easiest way to increase effective length-to-diameter ratio is to cement several specimens together. In this study bar, torsional, and longitudinal pulse velocities were measured on rock specimens (granite) and an aluminum standard consisting of up to seven segments cemented together. Maximum error was about 1 percent, which is larger than can be predicted from expected traveltime in the cement.-VSN

**Burley, B. J.** *See* Lin, S. B. 01223

01303 **Busch, F. E.; Hudson, J. D.** Ground-water levels in New Mexico, 1967: Santa Fe, N. Mex., New Mexico State Engineer (Basic Data Rept.), 74 p., illus., tables, 1969.

This report tabulates annual measurements of water level in a network of about 1,500 observation wells in New Mexico. The areas of ground-water observation are in seven major surface-water drainage basins or groups of basins-most are in areas where ground water is used in large quantities for irrigation, municipal, or industrial purposes. The program of ground-water observation conducted by the U.S. Geological Survey is in cooperation with the State Engineer of New Mexico, and is necessary to evaluate ground-water resources of the State.-Authors' abstract

07295 **Busch, W. L.** Mineral production in Illinois in 1967: Illinois Geol. Survey Circ. 435, 22 p., illus., tables, 1968.

The value of minerals reported produced in Illinois for 1967 totaled 650 million dollars. This was the highest annual value ever recorded for mineral production in the state and exceeded by 6 million dollars the former all-time high value of 644 million dollars in 1966. The wide range of economic activity carried on in Illinois and neighboring states consumes large quantities of various mineral materials. The information recorded in the tables and maps of this report summarizes the amounts and values of fuels, building and construction materials, and minerals for specialized industries that were produced in Illinois during 1967.-Author's abstract

**Bush, Darrell C.** *See* Granberry, Raymond J. 07278

**Butler, J. Robert.** *See* Ragland, Paul C. 01440

01513 **Butler, J. Robert.** Field and petrographic relationships among intrusive rocks of the Carolina Piedmont [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 4, Southeastern Sec., p. 12, 1969.

01290 **Byerlee, James D.; Brace, William F.** High-pressure mechanical instability in rocks: Science, v. 164, no. 3880, p. 713-715, illus., 1969.

At a confining pressure of a few kilobars, deformation of many sedimentary rocks, altered mafic rocks, porous volcanic rocks, and sand is ductile, in that instabilities leading to audible elastic shocks are absent. At pressures of 7 to 10 kb, however, unstable faulting and stick-slip in certain of these rocks was observed. This high pressure-low temperature instability might be responsible for earthquakes in deeply buried sedimentary or volcanic sequences.-Authors' abstract

**Byerly, Perry.** *See* Dewey, James. 01398

01226 **Byers, P. N.** Mineralogy and origin of the upper Eastend and Whitemud Formations of south-central and southwestern Saskatchewan and southeastern Alberta: Canadian Jour. Earth Sci., v. 6, no. 2, p. 317-334, illus., 1969.

The Upper Cretaceous non-marine Whitemud Formation consists of kaolinitic, metamorphic lithic sands and silts, and kaolinitic clays; the lithic grains are the major constituent, with kaolinitic clay a minor component. The upper part of the Eastend Formation, which conformably underlies the Whitemud, contains non-marine sands, silts, and clays; kaolin is very rare. Volcanic lithic grains are predominant. The contact is characterized upward by: a decrease in volcanic lithic grains and an increase in metamorphic lithic grains, the appearance of kaolin and disappearance of biotite and apatite, a slight increase in clear angular quartz and muscovite and a decrease in feldspar. The Whitemud correlates with the Colgate Member of the Fox Hills Formation in Montana and North Dakota. The formations were derived from Precambrian and Paleozoic and Mesozoic rocks in Montana.-*from* Author's abstract

01185 **Cadigan, R. A.** Distribution of mercury in the Navajo Sandstone, Colorado Plateau region, *in* Geological Survey research 1969, Chap. B: U.S. Geol. Survey Prof. Paper 650-B, p. B94-B100, illus., tables, 1969.

Mercury values in the Navajo Sandstone vary regionally in a nonrandom pattern. The pattern indicates the presence of anomalous concentrations of high values which may be related to hydrologic phenomena and to economically significant mineralization. The highest values of mercury, silver, and copper were found in an elongated group of adjacent localities that are alined parallel to regional structural lineament.-Author's abstract

07134 **Cady, Wallace M.** The lateral transition from the miogeosynclinal to the eugeosynclinal zone in northwestern New England and adjacent Quebec, Chap. 11 *in* Studies of Appalachian geology, northern and marine (Zen, E-an, and others, editors): New York and London, Interscience Publishers, p. 151-161, illus., 1968.

Lower and middle Paleozoic stratigraphic relations between the eugeosynclinal and miogeosynclinal zones in northwestern New England and adjacent Quebec are shown in restored sections. Both zones are comprised of variously metamorphosed marine bedded rocks, which rest unconformably on the Precambrian basement. Three geanticlines are recognized in the region. Lateral transition from the eugeosynclinal zone northwestward into the miogeosynclinal zone in the lower Paleozoic rocks is in the vicinity of the Vermont-Quebec geanticline, which is the most northwestern of the three geanticlines. By middle Paleozoic this transition zone had moved southeast and was located between the Stoke Mountain and Somerset geanticlines.-JWC

**Cain, J. Allen.** *See* Banks, Philip O. 01319

01346 **Callahan, James E.; Wanek, Alexander A.** Geologic reconnaissance of possible powersites at Tyee, Eagle, and Spur Mountain Lakes, southeastern Alaska: U.S. Geol. Survey Bull. 1211-B, p. B1-B34, illus., table, geol. maps, 1969.

These lakes fill glacially scoured basins in Coast Range granitic and high-rank metamorphic rocks. Spur Mountain Lake damsite on granodiorite and diorite has two disadvantages-narrowness of the ridge that forms the right abutment and two prominent high-angle joint sets; two possible tunnel routes are across intrusives of similar physical properties. Abutments of Tyee Lake damsite are in massive quartz diorite, the channel section filled with coarse talus too porous to grout; rocks of the

tunnel and penstock route are impermeable except possibly along two zones of joints. At Eagle Lake outlet a possibly leaky damsite is underlain by foliated gneiss interlayered with banded quartz diorite, concealed by thin soil and colluvium. Downstream 2 1/2 miles, Little Eagle Lake drainage area and storage capacity might be 70 percent greater; the dam would have to be 3 to 4 times longer, but large volumes of impervious fill material are available.-GDC

**Calvert, S. E.** *See* Ernst, W. G. 01274

01222 **Cameron, E. M.** Regional geochemical study of the Slave Point carbonates, western Canada: Canadian Jour. Earth Sci., v. 6, no. 2, p. 247-268, illus., 1969.

The subsurface of 35,000 sq mi area was studied to relate chemical variation to facies change; 90 wells were utilized. R-mode factor analysis methods have been used to help interpret the distribution of elements. There are slight but significant chemical variations between limestones occurring close to dolomites and gas discoveries distant from these features, e.g., a smaller Mg and Sr content in solid solution in the calcite, and less clay minerals and pyrite in limestones occurring near gas discoveries. These differences are used to form a multivariate discriminant function separating the two groups of limestones, and the function can be used to classify the different limestone sections. Sphalerite occurs principally along the margin of the shale basin.-*from* Author's abstract

**Campbell, F. A.** *See* Lerbekmo, J. F. 01208

01079 **Canada Geological Survey.** Aeromagnetic series, Sheets 43 C/15 and 43 C/16, District of Kenora, Ontario: Canada Geol. Survey Geophysics Papers 3901 and 3924, scale 1:63,360, 1969.

01080 **Canada Geological Survey.** Aeromagnetic series, Sheets 43 F/2, 43 F/7, 43 F/10 and 43 F/15, District of Kenora, Ontario: Canada Geol. Survey Geophysics Papers 3902-3905, scale 1:63,360, 1969.

01081 **Canada Geological Survey.** Aeromagnetic series, Sutton Lake South, District of Kenora, Ontario: Canada Geol. Survey Geophysics Paper 3906, scale 1:63,360, 1969.

01082 **Canada Geological Survey.** Aeromagnetic series, Sutton Lake North, District of Kenora, Ontario: Canada Geol. Survey Geophysics Paper 3907, scale 1:63,360, 1969.

01083 **Canada Geological Survey.** Aeromagnetic series, Warchesku Lake, District of Kenora, Ontario: Canada Geol. Survey Geophysics Paper 3908, scale 1:63,360, 1969.

01084 **Canada Geological Survey.** Aeromagnetic series, Sheet 43 K/15, District of Kenora, Ontario: Canada Geol. Survey Geophysics Paper 3909, scale 1:63,360, 1969.

01085 **Canada Geological Survey.** Aeromagnetic series, Sheet 43 N/2 and part of 43 N/7, District of Kenora, Ontario: Canada Geol. Survey Geophysics Paper 3910, scale 1:63,360, 1969.

01086 **Canada Geological Survey.** Aeromagnetic series, Sheets 43 F/1, 43 F/8 and 43 F/9, District of Kenora, Ontario: Canada Geol. Survey Geophysics Papers 3925-3927, scale 1:63,360, 1969.

01087 **Canada Geological Survey.** Aeromagnetic series, Opinnagau Lake, District of Kenora, Ontario: Canada Geol. Survey Geophysics Paper 3928, scale 1:63,360, 1969.

01088 **Canada Geological Survey.** Aeromagnetic series, Sheets 43 K/1, 43 K/8, 43 K/9 and 43 K/16, District of Kenora, Ontario: Canada Geol. Survey Geophysics Papers 3929-3932, scale 1:63,360, 1969.

01089 **Canada Geological Survey.** Aeromagnetic series, Burntpoint Creek and part of Sheet 43 N/8, District of Kenora, Ontario: Canada Geol. Survey Geophysics Paper 3933, scale 1:63,360, 1969.

01090 **Canada Geological Survey.** Aeromagnetic series, Sheets 43 B/13 and 43 B/14, District of Kenora, Ontario: Canada Geol. Survey Geophysics Papers 3947 and 3970, scale 1:63,360, 1969.

01091 **Canada Geological Survey.** Aeromagnetic series, Chedakuz Creek, British Columbia: Canada Geol. Survey Geophysics Paper 5287, scale 1:63,360, 1969.

01092 **Canada Geological Survey.** Aeromagnetic series, Natalkuz Lake, British Columbia: Canada Geol. Survey Geophysics Paper 5288, scale 1:63,360, 1969.

01093 **Canada Geological Survey.** Aeromagnetic series, Tetachuck Lake, British Columbia: Canada Geol. Survey Geophysics Paper 5289, scale 1:63,360, 1969.

01094 **Canada Geological Survey.** Aeromagnetic series, Tlutlias Creek, British Columbia: Canada Geol. Survey Geophysics Paper 5290, scale 1:63360, 1969.

01095 **Canada Geological Survey.** Aeromagnetic series, St. Thomas River, British Columbia: Canada Geol. Survey Geophysics Paper 5291, scale 1:63,360, 1969.

01096 **Canada Geological Survey.** Aeromagnetic series, Whitesail Reach, British Columbia: Canada Geol. Survey Geophysics Paper 5292, scale 1:63,360, 1969.

01097 **Canada Geological Survey.** Aeromagnetic series, Ghitezli Lake, British Columbia: Canada Geol. Survey Geophysics Paper 5293, scale 1:63,360, 1969.

01098 **Canada Geological Survey.** Aeromagnetic series, Marilla, British Columbia: Canada Geol. Survey Geophysics Paper 5294, scale 1:63,360, 1969.

01099 **Canada Geological Survey.** Aeromagnetic series, Cheslatta Lake, British Columbia: Canada Geol. Survey Geophysics Paper 5295, scale 1:63,360, 1969.

01100 **Canada Geological Survey.** Aeromagnetic series, Knapp Lake, British Columbia: Canada Geol. Survey Geophysics Paper 5296, scale 1:63,360, 1969.

01101 **Canada Geological Survey.** Aeromagnetic series, Takysie Lake, British Columbia: Canada Geol. Survey Geophysics Paper 5297, scale 1:63,360, 1969.

01102 **Canada Geological Survey.** Aeromagnetic series, Wistaria, British Columbia: Canada Geol. Survey Geophysics Paper 5298, scale 1:63,360, 1969.

01103 **Canada Geological Survey.** Aeromagnetic series, Nadina River, British Columbia: Canada Geol. Survey Geophysics Paper 5299, scale 1:63,360, 1969.

01104 **Canada Geological Survey.** Aeromagnetic series, Lamprey Creek, British Columbia: Canada Geol. Survey Geophysics Paper 5300, scale 1:63,360, 1969.

01105 **Canada Geological Survey.** Aeromagnetic series, Owen Lake, British Columbia: Canada Geol. Survey Geophysics Paper 5301, scale 1:63,360, 1969.

01106 **Canada Geological Survey.** Aeromagnetic series, Colleymount, British Columbia: Canada Geol. Survey Geophysics Paper 5302, scale 1:63,360, 1969.

01107 **Canada Geological Survey.** Aeromagnetic series, Burns Lake, British Columbia: Canada Geol. Survey Geophysics Paper 5303, scale 1:63,360, 1969.

01108 **Canada Geological Survey.** Aeromagnetic series, Endako, British Columbia: Canada Geol. Survey Geophysics Paper 5304, scale 1:63,360, 1969.

01109 **Canada Geological Survey.** Aeromagnetic series, Taltapin Lake, British Columbia: Canada Geol. Survey Geophysics Paper 5305, scale 1:63,360, 1969.

01110 **Canada Geological Survey.** Aeromagnetic series, Decker Lake, British Columbia: Canada Geol. Survey Geophysics Paper 5306, scale 1:63,360, 1969.

01111 **Canada Geological Survey.** Aeromagnetic series, Forestdale, British Columbia: Canada Geol. Survey Geophysics Paper 5307, scale 1:63,360, 1969.

01112 **Canada Geological Survey.** Aeromagnetic series, Houston, British Columbia: Canada Geol. Survey Geophysics Paper 5308, scale 1:63,360, 1969.

01113 **Canada Geological Survey.** Aeromagnetic series, Thautil River, British Columbia: Canada Geol. Survey Geophysics Paper 5309, scale 1:63,360, 1969.

01114 **Canada Geological Survey.** Aeromagnetic series, Telkwa, British Columbia: Canada Geol. Survey Geophysics Paper 5310, scale 1:63,360, 1969.

01115 **Canada Geological Survey.** Aeromagnetic series, Quick, British Columbia: Canada Geol. Survey Geophysics Paper 5311, scale 1:63,360, 1969.

01116 **Canada Geological Survey.** Aeromagnetic series, Topley, British Columbia: Canada Geol. Survey Geophysics Paper 5312, scale 1:63,360, 1969.

01117 **Canada Geological Survey.** Aeromagnetic series, Specularite Creek, British Columbia: Canada Geol. Survey Geophysics Paper 5313, scale 1:63,360, 1969.

01118 **Canada Geological Survey.** Aeromagnetic series, Cunningham Lake, British Columbia: Canada Geol. Survey Geophysics Paper 5314, scale 1:63,360, 1969.

01119 **Canada Geological Survey.** Aeromagnetic series, Trembleur Lake, British Columbia: Canada Geol. Survey Geophysics Paper 5315, scale 1:63,360, 1969.

01120 **Canada Geological Survey.** Aeromagnetic series, Tildesley Creek, British Columbia: Canada Geol. Survey Geophysics Paper 5316, scale 1:63,360, 1969.

01121 **Canada Geological Survey.** Aeromagnetic series, Fulton Lake, British Columbia: Canada Geol. Survey Geophysics Paper 5317, scale 1:63,360, 1969.

01122 **Canada Geological Survey.** Aeromagnetic series, Driftwood Creek, British Columbia: Canada Geol. Survey Geophysics Paper 5318, scale 1:63,360, 1969.

01123 **Canada Geological Survey.** Aeromagnetic series, Smithers, British Columbia: Canada Geol. Survey Geophysics Paper 5319, scale 1:63,360, 1969.

01124 **Canada Geological Survey.** Aeromagnetic series, Hyde Lake, District of Keewatin, Northwest Territories: Canada Geol. Survey Geophysics Paper 7164, scale 1:253,440, 1969.

01125 **Canada Geological Survey.** Aeromagnetic series, Edehon Lake, District of Keewatin, Northwest Territories: Canada Geol. Survey Geophysics Paper 7165, scale 1:253,440, 1969.

01126 **Canada Geological Survey.** Aeromagnetic series, Nueltin Lake, District of Keewatin, Northwest Territories: Canada Geol. Survey Geophysics Paper 7166, scale 1:253,440, 1969.

01127 **Canada Geological Survey.** Aeromagnetic series, Ennadai Lake, District of Keewatin, Northwest Territories: Canada Geol. Survey Geophysics Paper 7167, scale 1:253,440, 1969.

01128 **Canada Geological Survey.** Aeromagnetic series, Snowbird Lake, District of Mackenzie, Northwest Territories: Canada Geol. Survey Geophysics Paper 7168, scale 1:253,440, 1969.

01129 **Canada Geological Survey.** Aeromagnetic series, Wholdaia Lake, District of Mackenzie, Northwest Territories: Canada Geol. Survey Geophysics Paper 7169, scale 1:253,440, 1969.

01130 **Canada Geological Survey.** Aeromagnetic series, Abitau Lake, District of Mackenzie, Northwest Territories: Canada Geol. Survey Geophysics Paper 7170, scale 1:253,440, 1969.

01131 **Canada Geological Survey.** Aeromagnetic series, Boyd Lake, District of Mackenzie, Northwest Territories: Canada Geol. Survey Geophysics Paper 7180, scale 1:253,440, 1969.

01132 **Canada Geological Survey.** Aeromagnetic series, Rennie Lake, District of Mackenzie, Northwest Territories: Canada Geol. Survey Geophysics Paper 7181, scale 1:253,440, 1969.

01133 **Canada Geological Survey.** Aeromagnetic series, McCann Lake, District of Mackenzie, Northwest Territories: Canada Geol. Survey Geophysics Paper 7182, scale 1:253,440, 1969.

01134 **Canada Geological Survey.** Aeromagnetic series, Beaverhill Lake, District of Mackenzie, Northwest Territories: Canada Geol. Survey Geophysics Paper 7186, scale 1:253,440, 1969.

01135 **Canada Geological Survey.** Aeromagnetic series, Lynx Lake, District of Mackenzie, Northwest Territories: Canada Geol. Survey Geophysics Paper 7187, scale 1:253,440, 1969.

01136 **Canada Geological Survey.** Aeromagnetic series, Vernon, British Columbia: Canada Geol. Survey Geophysics Paper 7216, scale 1:253,440, 1969.

01137 **Canada Geological Survey.** Aeromagnetic series, Ashcroft, British Columbia: Canada Geol. Survey Geophysics Paper 7217, scale 1:253,440, 1969.

01138 **Canada Geological Survey.** Aeromagnetic series, Seymour Arm, British Columbia: Canada Geol. Survey Geophysics Paper 7219, scale 1:253,440, 1969.

01139 **Canada Geological Survey.** Aeromagnetic series, Quesnel Lake, British Columbia: Canada Geol. Survey Geophysics Paper 7221, scale 1:253,440, 1969.

01140 **Canada Geological Survey.** Aeromagnetic series, Nechako River, British Columbia: Canada Geol. Survey Geophysics Paper 7224, scale 1:253,440, 1969.

01141 **Canada Geological Survey.** Aeromagnetic series, Fort Fraser, British Columbia: Canada Geol. Survey Geophysics Paper 7226, scale 1:253,440, 1969.

01142 **Canada Geological Survey.** Aeromagnetic series, Winnipeg, Manitoba: Canada Geol. Survey Geophysics Paper 7301, scale 1:253,440, 1969.

01143 **Canada Geological Survey.** Aeromagnetic series, Selkirk, Manitoba: Canada Geol. Survey Geophysics Paper 7692, scale 1:253,440, 1969.

01144 **Canada Geological Survey.** Aeromagnetic series, Neepawa, Manitoba: Canada Geol. Survey Geophysics Paper 7693, scale 1:253,440, 1969.

01145 **Canada Geological Survey.** Aeromagnetic series, Hecla, Manitoba: Canada Geol. Survey Geophysics Paper 7706, scale 1:253,440, 1969.

01146 **Canada Geological Survey.** Aeromagnetic series, Dauphin Lake, Manitoba: Canada Geol. Survey Geophysics Paper 7707, scale 1:253,440, 1969.

01147 **Canada Geological Survey.** Aeromagnetic series, Duck Mountain, Manitoba: Canada Geol. Survey Geophysics Paper 7708, scale 1:253,440, 1969.

01148 **Canada Geological Survey.** Aeromagnetic series, Berens River, Manitoba: Canada Geol. Survey Geophysics Paper 7722, scale 1:253,440, 1969.

01149 **Canada Geological Survey.** Aeromagnetic series, Waterhen Lake, Manitoba: Canada Geol. Survey Geophysics Paper 7723, scale 1:253,440, 1969.

01150 **Canada Geological Survey.** Aeromagnetic series, Swan Lake, Manitoba: Canada Geol. Survey Geophysics Paper 7724, scale 1:253,440, 1969.

01151 **Canada Geological Survey.** Aeromagnetic series, Norway House, Manitoba: Canada Geol. Survey Geophysics Paper 7739, scale 1:253,440, 1969.

01152 **Canada Geological Survey.** Aeromagnetic series, The Pas, Manitoba-Saskatchewan: Canada Geol. Survey Geophysics Paper 7741, scale 1:253,440, 1969.

01153 **Canada Geological Survey.** Aeromagnetic series, Whitesail Lake, British Columbia: Canada Geol. Survey Geophysics Paper 7750, scale 1:253,440, 1969.

01154 **Canada Geological Survey.** Aeromagnetic series, Smithers, British Columbia: Canada Geol. Survey Geophysics Paper 7760, scale 1:253,440, 1969.

01155 **Canada Geological Survey.** Aeromagnetic series, Kluane Lake, Yukon Territory: Canada Geol. Survey Geophysics Paper 7827, scale 1:253,440, 1969.

01156 **Canada Geological Survey.** Aeromagnetic series, Sheldon Lake, Yukon Territory: Canada Geol. Survey Geophysics Paper 7838, scale 1:253,440 [1969?].

01157 **Canada Geological Survey.** Aeromagnetic series, Tay River, Yukon Territory: Canada Geol. Survey Geophysics Paper 7839, scale 1:253,440 [1969?].

01158 **Canada Geological Survey.** Aeromagnetic series, Snag, Yukon Territory: Canada Geol. Survey Geophysics Paper 7840, scale 1:253,440, 1969.

01159 **Canada Geological Survey.** Aeromagnetic series, Niddery Lake, Yukon Territory: Canada Geol. Survey Geophysics Paper 7852, scale 1:253,440 [1969?].

01160 **Canada Geological Survey.** Aeromagnetic series, Lansing, Yukon Territory: Canada Geol. Survey Geophysics Paper 7853, scale 1:253,440 [1969?].

01161 **Canada Geological Survey.** Aeromagnetic series, Stewart River, Yukon Territory: Canada Geol. Survey Geophysics Paper 7854, scale 1:253,440, 1969.

01162 **Canada Geological Survey.** Aeromagnetic series, Dawson, Yukon Territory: Canada Geol. Survey Geophysics Paper 7868, scale 1:253,440, 1969.

01163 **Canada Geological Survey.** Aeromagnetic series, Polar continental Shelf, Cape M'-Clure, District of Franklin, Northwest Territories: Canada Geol. Survey Geophysics Paper 8071, scale 1:253,440, 1969.

01164 **Canada Geological Survey.** Aeromagnetic series, Polar continental shelf, Gore Islands, District of Franklin, Northwest Territories: Canada Geol. Survey Geophysics Paper 8072, scale 1:253,440, 1969.

01165 **Canada Geological Survey.** Aeromagnetic series, Polar continental shelf, Sheet 108 E, District of Franklin, Northwest Territories: Canada Geol. Survey Geophysics Paper 8073, scale 1:253,440, 1969.

01166 **Canada Geological Survey.** Aeromagnetic series, Polar continental shelf, Dyer Bay, District of Franklin, Northwest Territories: Canada Geol. Survey Geophysics Paper 8089, scale 1:253,440, 1969.

01167 **Canada Geological Survey.** Aeromagnetic series, Polar continental shelf, Sheets 98 G, 108 H, 108 G, District of Franklin, Northwest Territories: Canada Geol. Survey Geophysics Papers 8090-8092, scale 1:253,440, 1969.

01168 **Canada Geological Survey.** Aeromagnetic series, Polar continental shelf, Sheet 109 C, District of Franklin, Northwest Territories: Canada Geol. Survey Geophysics Paper 8122 (2d edition), scale 1:253,440, 1969; originally published 1968.

07143 **Canada Geological Survey.** Aeromagnetic series, Niddery Lake, Yukon Territory: Canada Geol. Survey Geophysics Paper 4345, scale 1:63,360, 1968.

07327 **Canada Geological Survey.** Aeromagnetic series, Sheets 43 C/13 and 43 C/14, District of Kenora, Ontario: Canada Geol. Survey Geophysics Papers 3856 and 3877, scale 1:63,360, 1968.

07305 **Cannon, H. L.; Hopps, H. C.** Environmental geochemistry-Health and disease: Science, v. 162, no. 3865, p. 815, 1968.

This is an announcement of the symposium on "Environmental geochemistry in relation to human health and disease," to be held December 30, 1968, at the AAAS meeting in Dallas under the sponsorship of the GSA. The symposium is designed to explore various geochemical and biomedical factors affecting health and to summarize the present status of knowledge in those fields. Subtle multifactorial causes of suboptimal health due to minor deficiencies or excesses of elements should be sought; some of these may also in time produce diseases once thought to be "inherent." An exhaustive and rigorous comparison of geographic disease patterns with geological and geochemical maps in the search for causal relationships may be an appropriate entry into the problem of nonoptimal levels of certain elements known to be injurious to the health of humans and animals.-DBV

07186 **Cannon, William Francis.** Plutonic evolution of the Cutler area, Ontario [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 29, no. 4, p. 1402B, 1968.

**Card, K. D.** *See* Robertson, J. A. 01227

01253 **Carlston, Charles W.** Downstream variations in the hydraulic geometry of streams-Special emphasis on mean velocity: Am. Jour. Sci., v. 267, no. 4, p. 499-509, illus., table, 1969.

The equation for the relation of downstream increase in discharge to downstream changes in hydraulic geometry is a power function in which the exponents for width, depth, and velocity have been determined by Leopold and Maddock to be 0.5, 0.4, and 0.1, respectively. The least squares solution for the mean exponent in ten analyzed river basins is width = 0.461, depth = 0.383, and velocity = 0.155. The most common relationships on long segments of rivers is a nearly constant velocity; however, many smaller streams may increase or decrease velocity downstream because of geological influences present at the mean annual discharge level. Large rivers accomodate downstream increase in discharge principally through increase in depth, and smaller streams through increase in width.-*from* Author's abstract

01341 **Carmichael, Dugald M.** On the mechanism of prograde metamorphic reactions in quartz-bearing pelitic rocks: Contr. Mineralogy and Petrology, v. 20, no. 3, p. 244-267, illus., 1969.

An empirical method is described whereby the sequence of textural changes from one zone to the next may be reconciled with balanced metamorphic reactions. The textures of a single thin section are used to deduce a set of metasomatic cation-exchange reactions which proceed in different microscopic domains of the rock, but which add up on the scale of the whole thin section, to give the balanced metamorphic reaction. Each subsystem is closed to Al but open to the more mobile cations which are free to travel from one subsystem to another, subject to the requirement of short-range electrostatic neutrality and to the assumption that the system is closed on the scale of the whole thin section. Evidence is given to support the postulation that the Al is relatively immobile.-*from* Author's abstract

01514 **Carpenter, David W.** Depositional features of alluvial sandstones exposed by strip-mine excavation in Preston County, West Virginia [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 4, Southeastern Sec., p. 12-13, 1969.

01515 **Carpenter, James H.** Chemical cycles in estuaries [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 4, Southeastern Sec., p. 13, 1969.

**Carpenter, John R.** *See* Libby, W. G. 01068

**Carpenter, John R.** *See* Phyfer, Daniel W. 01433

01516 **Carpenter, John R.; Ragland, Paul C.** Distribution of transition metals in the western stock of the Farrington (North Carolina) complex [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 4, Southeastern Sec., p. 13-14, 1969.

01218 **Carr, P. A.** Salt-water intrusion in Prince Edward Island: Canadian Jour. Earth Sci., v. 6, no. 1, p. 63-74, illus., tables, 1969.

The numerous saline estuaries situated throughout Prince Edward Island permits high tides to carry salt water a long way inland and to penetrate the bedrock aquifer. This salty water extends as far as 1,200 feet inland and has penetrated to a depth of 185 feet. Beneath this salty water is fresh ground water, which extends down to about 600 feet where it is underlain by salty water. The salty water in the upper 185 feet of the aquifer is not separated from the fresh ground water by a confining stratum, but is kept in this position by the higher head of the fresh ground water. This head maintains a dynamic equilibrium with the heavier salty water. The effect of density in maintaining the position of a fresh and salt water front is not as important as has been previously thought.-*from* Author's abstract

**Carswell, Louis D.** *See* Vecchioli, John. 01197

07221 **Cary, Allen S.** Cascade border dam sites, *in* Assoc. Eng. Geologists, 1968 Natl. Mtg., Seattle, Wash., Guidebook to field trips: [Sacramento, Calif.] Assoc. Eng. Geologists, p. 58-67, illus., 1968.

Postglacial channels and canyons present tempting dam sites, and each has its own unique features. Details of the geology at the Tolt River-South Fork, Snoqualmie River-North Fork, Mud Mountain, and Cedar dam sites are described. All are associated with the postglacial channeling of glacial deposits.-HRC

07225 **Cary, Allen S.** Military Road slide, *in* Assoc. Eng. Geologists, 1968 Natl. Mtg., Seattle, Wash., Guidebook to field trips: [Sacramento, Calif.] Assoc. Eng. Geologists, p. 79-84, illus., 1968.

Hummocky topography near the Military Road overpass of the Seattle-Tacoma freeway is attributed to landsliding rather than to glacial kames as previously suggested. The drainage of glacial Lake Russell was the triggering mechanism for the sliding which has been reactivated by local quarrying for borrow material. In every cut of appreciable size in the area there is evidence of sliding, such as offset beds, tilted silt and clay layers, and slickensided surfaces. Grooves suggest that sliding is relatively recent also, and not necessarily connected with the borrowing.-HRC

01228 **Chandler, F. W.; Young, G. M.; Wood, J.** Diaspore in early Proterozoic quartzites (Lorrain Formation) of Ontario: Canadian Jour. Earth Sci., v. 6, no. 2, p. 337-340, illus., 1969.

Diaspore and kaolinite occur in quartzites of the Huronian Lorrain Formation in both the Bruce Mines and Flack Lake areas north of Lake Huron, Ontario. Regional metamorphism in part converted these aluminous minerals to pyrophyllite. A later redistribution of silica and water resulted in partial conversion of diaspore and, to a lesser extent pyrophyllite, to a second generation of kaolinite.-Authors' abstract

01358 **Chandra, Umesh.** The exact solution for the displacement components in $P_1P_2P_1$, $(S_1S_2S)_{sF}$, $(S_1S_2S_1)_{sA}$ head waves due to an impulsive double couple source: Seismol. Soc. America Bull., v. 59, no. 1, p. 317-330, illus., 1969.

Exact integral expressions for the displacement components as a function of azimuth, in three types of head waves due to an impulsive double-couple source of arbitrary orientation in two semi-infinite media separated by a plane horizontal boundary, and the effect of free surface on it, have been obtained. The time variation of the source is assumed to be represented by the Heaviside unit function. The response due to an arbitrary source excitation may, however, be obtained from this solution by superposition. Necessary formulas for the operational interpretation of integral equations occurring in the problem are given. Illustrative examples showing the waveform in displacement components of these head-waves for a particular fault and a suitably

chosen Earth model are given. Plots of the projection of particle trajectory for P and S waves in different planes are given for different azimuths.-*from* Author's abstract

**Chao, T. T.** *See* Jenne, E. A. 01485

07256 **Chapman, Carleton A.** A comparison of Maine coastal plutons and the magmatic central complexes of New Hampshire, Chap. 29 *in* Studies of Appalachian geology, northern and marine (Zen, E-an, and others, editors): New York and London, Interscience Publishers, p. 385-396, illus., 1968.

Well exposed along the eastern half of the Maine coastal region are numerous Late Devonian granitic intrusions of stock-like form known as the Maine coastal plutons. The rocks of the White Mountain Magma Series of New Hampshire are Early Jurassic; they are mildly alkalic. The reticulate patterns of magmatic activity in the two areas suggest that the plutons developed from discrete bodies of magma formed deep within the Earth at nodes of two sets of steep fracture zones of low pressure. The plutons developed from closed polymagmatic chambers of roughly equant form. Ring fracturing led to final emplacement of the bodies. In the New Hampshire area syenitic rocks show a preference for ring dikes, whereas the granites occur as stocks. In the Maine area no syenitic magma probably formed, and the plutons are consequently entirely granite.-JWC

**Chappel, D.** *See* Bond, T. 01532

07152 **Charlesworth, Lloyd James, Jr.** Bay, inlet and nearshore marine sedimentation-Beach Haven-Little Egg Inlet region, New Jersey [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 29, no. 3, p. 1063B, 1968.

07341 **Charlier, Roger H.** Quantitative analysis, geometrics and morphometrics [with German and French summ.]: Zeitschr. Geomorphologie, new ser., v. 12, no. 4, p. 375-387, 1968.

Statistical analysis in the Earth Sciences, introduced 75 years ago and mostly concerned with quantitative measurements in paleontology, has spread not only in scope to embrace more and more disciplines, but also in frequency of use and acceptance. The term geometrics was proposed a decade ago for statistical geologic studies. The more generalized use of computers and ensuing reduction of man hours will enhance the use of statistical procedures in strata, sediment, geomorphic and other earth and marine science studies. Quantitative analysis is equally useful in those border disciplines of both geology and geography-physical geography, climatology, geomorphology, hydrography, and the like. In this paper, uses of statistical methods for the Earth Sciences in their broadest definition are stressed.-GDC

01240 **Chesterman, Charles W.; Silberman, M. L.; Gray, C. H., Jr.** Geology and geochronology of the Bodie mining district, Mono County, California [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 3, Cordilleran Sec., p. 10-11, 1969.

07253 **Chidester, Alfred H.** Evolution of the ultramafic complexes of northwestern New England, Chap. 26 *in* Studies of Appalachian geology, northern and marine (Zen, E-an, and others, editors): New York and London, Interscience Publishers, p. 343-354, illus., 1968.

The distribution of known ultramafic rocks in Vermont and northwestern Massachusetts is spotty, but the overall distribution from north to south forms a uniform belt. The association of the belt of ultramafic rocks with greenstones and amphibolites is striking, although the ultramafics occur in all types of country rock. The majority of the ultramafic complexes are intermediate in size-a few hundred to a thousand feet long and a few tens to hundreds of feet thick. They consist typically of a central core of serpentinite, massive at the center and schistose on the margins, surrounded by talc-magnesite rock and steatite. Some bodies contain appreciable dunite and peridotite. Intergradational layered relations of dunite, peridotite, and chromitite suggest that they were formed by gravity accumulation during rhythmically varied crystallization of a somewhat more complex source magma.-JWC

01275 **Chinner, G. A.; Smith, J. V.; Knowles, C. R.** Transition-metal contents of $Al_2SiO_5$ polymorphs: Am. Jour. Sci., v. 267-A (Schairer Volume), p. 96-113, illus., tables, 1969.

Electron probe measurements of minor elements in the range Na-Fe of natural andalusite, kyanite, and sillimanite indicate that (viridine excepted) the only elements occurring in amounts greater than 0.01 percent are Ti, V, Cr, and Fe; of these only Fe occurs regularly in amounts greater than 0.2 percent, although Cr in eclogite and glaucophane-schist kyanites may exceed this value. Abrupt spatial variation of Fe content across Al silicates indicates lack of equilibrium, probably caused by diffusion control of chemical supply during growth. In regional environments any influence of $Fe^{3+}$ on the occurrence of an Al-silicate in the stability field of another is probably overshadowed by other effects-in particular the metastable persistence of one polymorph after a change in P-T conditions.-*from* Authors' abstract

01394 **Chipman, David R.** Conversion of relative intensities to an absolute scale, *in* Accurate determination of X-ray intensities and structure factors, Internat. Mtg., Cambridge, England, 1968: Acta Cryst., v. A25, pt. 1, p. 209-213, illus., table; discussion, p. 213-214, 1969.

The determination of an absolute scale for X-ray intensities involves the experimental evaluation of a number of constants in the intensity equation whose values are not normally required. The absolute intensities so obtained will not be useful, in the present context, unless the overall accuracy can be maintained at about one percent or better. Some of the difficulties which can occur in making the measurements to the necessary accuracy are discussed.-Author's abstract

**Chodos, Arthur A.** *See* Albee, Arden L. 01236

**Christ, C. L.** *See* Clark, Joan R. 07322

**Christensen, Nikolas I.** *See* Crosson, Robert S. 01386

**Christian, Ralph P.** *See* Rose, Harry J., Jr. 01191

**Christie, J. M.** *See* Baker, D. W. 01321

**Chronic, John.** *See* Bolyard, Dudley W. 07267

07187 **Church, Barry Neil.** Geology of the White Lake area, British Columbia [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 29, no. 4, p. 1402B, 1968.

07234 **Churcher, C. S.** Pleistocene ungulates from the Bow River gravels at Cochrane, Alberta: Canadian Jour. Earth Sci., v. 5, no. 6, p. 1467-1488, illus., tables, 1968.

Five ungulates are reported from gravels comprising the second major terrace above the Bow River's north bank at Cochrane, Alberta. These ungulates are *Cervus canadensis* (wapiti), *Rangifer tarandus* (caribou) *Ovis canadensis* (mountain sheep), *Bison occidentalis* (extinct western bison), and *Equus conversidens* (extinct Mexican ass). *E. conversidens* was previously known from middle and late Pleistocene beds of the southern United States and Mexico and is here reported from the post-Wisconsin Pleistocene of Alberta and possibly Saskatchewan. Radiocarbon analysis of *Bison* bones from the gravels yielded two dates that averaged 11,065 B.P.-Author's abstract

07261 **Clair, Joseph R.; Volk, Richard W.** Pre-Permian Paleozoic rocks of the Las Animas arch-A new oil province, *in* Guidebook issue, southeastern Colorado: Mtn. Geologist, v. 5, no. 3, p. 95-108, illus., 1968.

The Las Animas arch of Colorado and Kansas was a Paleozoic shelf area in the Anadarko basin's Hugoton embayment, its northwest-oriented Mississippian and earlier folds masked by later deposition and uplift. It was a south-trending nose during Pennsylvanian and Permian time, with a well-defined eastern axis in Brandon field, and more subtle western axis in Eads field. Its present structure is the result of Laramide uplift (late Cretaceous-early Eocene). Of recently explored Mississippian

reservoirs, the Spergen Formation has shown most widespread hydrocarbon occurrence. Critical periods in entrapment were: depositional trap formation during the Mississippian; unconformable trap formation during and after pre-Pennsylvanian erosion; primary migration into traps during Pennsylvanian-Permian time; and readjustment of existing accumulations during Laramide uplift.-GDC

01216 **Clark, J. S.; Ross, G. J.** Reaction of mixed magnesium-aluminum and calcium-aluminum hydroxides with Wyoming bentonite: Canadian Jour. Earth Sci., v. 6, no. 1, p. 47-53, illus., tables, 1969.

Excess $AlCl_3$ was reacted with $Mg(OH)_2$ and $Ca(OH)_2$ in suspensions of Wyoming bentonite and the nature of the reaction products formed and their effect on the cation-exchange capacity (CEC) of the clay was determined. Reaction of $Mg(OH)_2$ and $AlCl_3$ with the clay produced marked decreases of the CEC in the bentonite, whereas much smaller decreases were observed in the Ca-Al-clay preparations. The decreases in the CEC were attributed to the formation of mixed Mg-Al and Ca-Al hydroxide clay complexes. The greater stability of the mixed Mg-Al hydroxide complexes with the clay appeared to account for the marked reduction of CEC in these systems.-Authors' abstract

07322 **Clark, Joan R.; Christ, C. L.** Crystal structure of veatchite: Naturwissenschaften, v. 55, no. 12, p. 648, table, 1968.

The chemical formula of veatchite has long been a subject of controversy. Solution of the crystal structure shows a structural formula corresponding to $4SrO.11B_2O_3.7H_2O$, which agrees with an early chemical analysis. The space group is *Aa* and cell dimensions are $a = 20.86$A, $b = 11.74$A, $c = 6.652$A, $\beta = 92.10°$. Coordinates of the atoms are given in the table. Veatchite is dimorphous with *p*-veatchite for which the structure was reported recently. Both minerals contain two infinite polyanion sheets; independent $B(OH)_3$ groups in the presence of these sheets were observed for the first time.-ESL

07135 **Clark, T. H.; Eakins, P. R.** The stratigraphy and structure of the Sutton area of southern Quebec, Chap. 12 *in* Studies of Appalachian geology, northern and marine (Zen, E-an, and others, editors): New York and London, Interscience Publishers, p. 163-173, illus., table, 1968.

The Sutton area of southern Quebec straddles the miogeosynclinal basin and adjacent edge of the eugeosynclinal trough of the Appalachian geosyncline. A facies change from a miogeosynclinal dolomite-quartzite-shale section on the west to a typical eugeosynclinal shale-graywacke-volcanic section on the east is displayed here. Compression and uplift along the Green Mountain-Sutton Mountain axial zone formed early folds and schistosity in deeply buried sediments. Pronounced compression produced the Green Mountain-Sutton Mountain anticlinorium, the tight Richford-Sutton syncline, the Pinnacle Mountain anticline, and extended westward into the Stanbridge Complex.-JWC

**Clarke, O. M., Jr.** *See* Smith, W. E. 07268

**Clifford, Tom N.** *See* Thompson, James B., Jr. 07242

01308 **Clifton, H. Edward; Hunter, Ralph E.; Swanson, Frederick J.; Phillips, R. Lawrence.** Sample size and meaningful gold analysis: U.S. Geol. Survey Prof. Paper 625-C, p. C1-C17, illus., tables, 1969.

It can be shown mathematically that, if several simplifying assumptions are made,the precision of a gold analysis is determined by the number of gold particles in the sample. The precision afforded by 20 particles per sample is deemed sufficient for most purposes. A graph can be used to determine, for different combinations of gold grade and particle size, the weight of sample expected to contain 20 particles. Modifications of the graph permit its use for other sample-size problems. If gold particle size varies, the precision of a gold analysis is determined partly by the degree of variability. Several methods may be used to determine sample weight where particle size va-

ries. Analyses of a natural sand sample demonstrate the use of the procedures for determining adequate sample size.-HEC

01304 **Cline, Denzel R.** Ground-water resources and related geology of north-central Spokane and southeastern Stevens Counties, Washington: Washington Dept. Water Resources Water Supply Bull. 27, 195 p., illus., tables, geol. map, 1969.

The project area lies in a basin surrounded by low mountains and contains several basalt-capped mesas. Many wells tapping granitic and metamorphic pre-Tertiary basement rocks, which underlie the basin and form the mountains, yield up to 35 gpm, sufficient water for domestic and stock use. Most wells tapping aquifers in the Tertiary formations yield generally less than 35 gpm. In three valleys, wells tapping unconsolidated Quaternary deposits yield several thousand gpm, whereas wells on the mesas and elsewhere yield from 5-600 gpm. Large ground-water withdrawals in the Spokane area have not affected regional water levels. Most wells yield a hard or moderately hard calcium magnesium bicarbonate water that is generally of good quality, except where iron concentrations are excessive.-*from* Author's abstract

**Coats, Keith Hal.** *See* Katz, Donald LaVerne. 07290

**Cocanower, R. D.** *See* Morris, Billy P. 07282

01347 **Cohen, Philip; Franke, O. L.; McClymonds, N. E.** Hydrologic effects of the 1962-66 drought on Long Island, New York: U.S. Geol. Survey Water-Supply Paper 1879-F, p. F1-F18, illus., 1969.

The hydrologic system of Long Island, N.Y., showed a marked response to deficient precipitation in the years 1962-66. By 1966, streamflow was the lowest of record in many Long Island streams, and ground-water levels had declined a maximum of about 10 feet in the central part of the island. Although the drought apparently ended in the early months of 1967 and ground-water levels and streamflow recovered somewhat since then, ground-water levels and streamflow were still considerably below long-term average values in September 1968.-Authors' abstract

**Cok, Anthony E.** *See* Stanley, Daniel J. 07340

**Colquhoun, D. J.** *See* Pierce, J. W. 01434

**Colquhoun, D. J.** *See* Bond, T. 01532

01295 **Condie, Kent C.; Leech, A. P.; Baadsgaard, H.** Potassium-argon ages of Precambrian mafic dikes in Wyoming: Geol. Soc. America Bull., v. 80, no. 5, p. 899-905, illus., table, 1969.

Potassium-argon dating of whole-rock contact zones from 27 Precambrian mafic dikes in Wyoming suggests several periods of intrusion in the time interval 700 to 2,500 m.y. A widespread period at 1,900 to 2,200 m.y. is suggested by the data.-Authors' abstract

**Conkin, Barbara M.** *See* Conkin, James E. 01517

01517 **Conkin, James E.; Conkin, Barbara M.** Middle Devonian bone beds of Jefferson County, Kentucky and southern Indiana [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 4, Southeastern Sec., p. 14, 1969.

**Conley, James F.** *See* Toewe, E. Clayton. 01554

01209 **Cooke, D. L.; Moorhouse, W. W.** Timiskaming volcanism in the Kirkland Lake area, Ontario, Canada: Canadian Jour. Earth Sci., v. 6, no. 1, p. 117-132, illus., tables, 1969.

The initial phase was characterized by calc-alkaline lavas transitional between the Timiskaming and underlying calcic Keewatin greenstones. Flows of alkalic mafic

trachytes and a variety of leucitic lavas and pyroclastics are the latest differentiates represented. These are the first known Precambrian leucite volcanics. Sedimentation and intrusion of other igneous rocks were contemporaneous with the volcanism, but intrusions of feldspar porphyry were post-Timiskaming. The Kirkland Lake sequence is compared with similar exotic, but less altered lavas of more recent age in order to clarify their nature. The alkalic association at Kirkland Lake is similar to those of the late stages in the cycle of modern volcanic arcs and along orogenic belts marginal to major continental masses.-*from* Authors' abstract

**Coombs, Howard.** *See* Association Eng. Geologists. 07212

07223 **Coombs, Howard.** George Culmback (Sultan) dam, *in* Assoc. Eng. Geologists, 1968 Natl. Mtg., Seattle, Wash., Guidebook to field trips: [Sacramento, Calif.] Assoc. Eng. Geologists, p. 75-76, 1968.

Geologically, the dam site is of interest because of the effective blocking of the Sultan River at the site and its diversion into a new channel. A valley glacier moved down Sultan Valley and entered Pilchuk River valley, and at the same time a lobe of the Puget continental glacier entered Pilchuk Valley. Drainage modifications resulted, including a box canyon six miles long where the Pilchuk was reversed. The date of the diversion is placed at 13,000 to 14,000 B.P. The morainal dam serves as an effective reservoir barrier also. Bedrock at the dam is metagraywacke, tightly folded, and standing almost vertical.-HRC

07228 **Coombs, Howard.** Upper Skagit River dams, *in* Assoc. Eng. Geologists, 1968 Natl. Mtg., Seattle, Wash., Guidebook to field trips: [Sacramento, Calif.] Assoc. Eng. Geologists, p. 102-107, 1968.

Pertinent data on numerous dams in this river system are presented; they include Ross, Diablo, and Gorge dams. The bedrock conditions and some of the special problems associated with each site are discussed. Ross dam, for instance, on migmatite scoured by alpine glaciers, and with much jointing, required grouting. Diablo dam is on the same gneiss, but the rock itself is used for the spillways. Gorge dam is W-shaped; gravity dams are on each flank, and an arch dam is in the center to accomodate the bedrock foundation shape.-HRC

**Cooper, James B.** *See* Purtymun, William D. 01196

**Copeland, B. J.** *See* Odum, Howard T. 01441

01251 **Cowgill, Ursula M.; Hutchinson, G. Evelyn.** A chemical and mineralogical examination of the ceramic sequence from Tikal, El Petén, Guatemala: Am. Jour. Sci., v. 267, no. 4, p. 465-477, illus., tables, 1969.

Thirty potsherds ranging from Tzec (Mamon) to Caban (Early post-classic) complex were examined for their concentration of 21 chemical elements as well as their crystalline content in the hope that it might facilitate many of the problems facing the ceramicist as well as establish a source for the material encountered in the sherds. Comparison with the clay of El Bajo de Santa Fé makes it unlikely that this, the nearest source of clay to Tikal, was actually used. The clay used by the potters was montmorillonitic. Trade sherds are distinguishable chemically from locally-derived ones. Firing temperatures can be determined; they decreased with increasing age of the civilization.-*from* Authors' abstract

**Cowles, John.** *See* Frey, Robert W. 01501

07330 **Cox, Allan; Doell, Richard R.; Dalrymple, G. Brent.** Radiometric time-scale for geomagnetic reversals: Geol. Soc. London Quart. Jour., v. 124, pt. 1, no. 493, p. 53-66, illus., tables, 1968.

A time-scale for polarity reversals of the geomagnetic field has been established for the last 4.1 m.y., using the potassium-argon method of dating rocks. Data for this time-scale consist of polarity- and age-determinations for about 240 rocks made by a

number of workers; these are summarized in tabular form. At least 17 geomagnetic reversals occurred during the period covered, and intervals of constant polarity ranged in length from 700,000 years to about 50,000 years or less. Two possible correlations of this time-scale with the Pliocene-Pleistocene boundary are discussed. In several parts of the world glacial deposits have been shown to be as old as 3 m.y., in some cases by application of the reversal time-scale either on land or in deep-sea sediment cores.-*from* Authors' abstract

07292 **Cramer, Fritz H.** Palynologic microfossils of the Middle Silurian Maplewood Shale in New York [with French abs.]: Rev. Micropaléontologie, v. 11, no. 2, p. 61-70, illus., table, 1968.

The Maplewood green shale, exposed over a restricted area in western New York, is one of the lowermost shale units of the Clinton Group; the megafauna indicates late Llandoverian or early Wenlockian age. The Maplewood is slightly older than the Formigoso Formation of Spain, from which Cramer (1964, 1966) has described large palynomorph assemblages. The microfossils treated in this paper, all from the type section in the Genesee Gorge, Rochester, consist of many taxa of acritarchs, some chitinozoans and scolecodonts, and very few plant spores. *Carminella*, n. gen., and three new species of acritarchs, *C. maplewoodensis*, *Baltisphaeridium fisherii*, *Tunisphaeridium evitti*, are described. Previous records are listed for 17 other acritarchs common in the Maplewood, and one plant spore.-VMJ

01212 **Cramer, Howard Ross.** Structural features of the Coastal Plain of Georgia: Southeastern Geology, v. 10, no. 2, p. 111-123, illus., 1969.

Twenty-eight structural features of the Georgia Coastal Plain are compiled on a map and the bases of their recognition are outlined. They are divided into tectonic framework features (Okefenokee and Appalachicola Embayments with intervening Central Georgia Uplift), folds (predominantly the Chattahoochee Anticline), and faults (most, if not all, normal). The framework appears to be both Cretaceous and Cenozoic in age, whereas the folding and faulting appear to be Cenozoic. One new feature, the Charlton High, is suggested from the absence of Oligocene rocks in Charlton County. Southwest-northeast alignment of the features, and of gravity and magnetic anomalies, is evident. Tension appears to have been a predominant source of energy for the faulting.-*from* Author's abstract

01372 **Crawford, Carl B.; Eden, William J.** Stability of natural slopes in sensitive clay-Closure [to discussion of paper 5324, 1967]: Am. Soc. Civil Engineers Proc., v. 95, paper 6429, Jour. Soil Mechanics and Found. Div., no. SM 2, p. 628-630, illus., 1969.

Two points raised in the discussion are considered. The Breckenridge slide [Ottawa area, Ontario, paper 5324, ibid., v. 93, no. SM 4, p. 419-436, 1967] occurred at night with no witnesses. The authors agree that the initial slide may not have involved the entire bank, but do not believe that it passed below or through the toe of the slope. Low stress level tests were done on samples taken just below the failure surface of the slide. It is difficult to visualize a bonded clay with the shear parameters obtained without accepting the discussers' second point, that it may fail as a material with an inherent system of defects. Further evidence was noted in later slides. These recent tests justify a revised approach to stability analyses of slopes in Leda clays.-ESL

01066 **Crawford, Johnson; Fulweiler, R. E.; Miller, H. W.** Mine geology of the New Jersey Zinc Company's Jefferson City mine, *in* Papers on the stratigraphy and mine geology of the Kingsport and Mascot formations (Lower Ordovician) of East Tennessee: Tennessee Div. Geology Rept. Inv. 23, p. 64-75, illus., 1969.

Solution of the underlying Kingsport Formation has resulted in the collapse of the overlying Mascot Dolomite. The ore occurs primarily in two different environments, the more common of which is a bedded-type deposit in which the ore occurs in coarse-matrix breccias in the limestone. Reef occurrences are dark and light, banded, coarsely-crystalline dolomite masses that rest upon fine-grained dolomite and are surrounded by limestone. Sphalerite occurs in a 4- to 6-inch band that caps

the structure, but is also found in the dolomite; the structures resemble stromatolites, hence the term 'reef.' The ore consists of low-iron sphalerite in a dolomite gangue. There is considerable post-ore structural deformation.-HRC

07335 **Crippen, R. G.; Wright, A. C.** Procedures and techniques employed in logging and evaluating high angle well bores on a large scale drilling and development program, *in* SPWLA Logging Symposium, 9th Ann., New Orleans, La., 1968, Trans.: Houston, Tex., Soc. Prof. Well Log Analysts, p. C1-C25, illus., 1968.

High angle holes in the East Wilmington Field, Long Beach Unit area, are currently being drilled and successfully logged. These holes deviate as much as 75° from the vertical, but can be satisfactorily logged with pump-down tools. The quality of the induction-electric log produced compares favorably with standard logging tools. Auxiliary tools are being miniaturized to provide fuel service for high angle wells.-KAF

01386 **Crosson, Robert S.; Christensen, Nikolas I.** Transverse isotropy of the upper mantle in the vicinity of Pacific fracture zones: Seismol. Soc. America Bull., v. 59, no. 1, p. 59-72, illus., tables, 1969.

Several recent investigations suggest that portions of the Earth's upper mantle behave anisotropically to seismic wave propagation. Since several types of anisotropy can produce azimuthal variations in $P_n$ velocities, it is of particular geophysical interest to provide a framework for the recognition of the form or forms of anisotropy most likely to be manifest in the upper mantle. In this paper upper mantle material is assumed to possess the elastic properties of transversely isotropic media. Equations are presented which relate azimuthal variations in $P_n$ velocities to the direction and angle of tilt of the symmetry axis of a transversely isotropic upper mantle. It is shown that the velocity data of Raitt and Shor taken near the Mendocino and Molokai fracture zones can be adequately explained by the assumption of transverse isotropy with a nearly horizontal symmetry axis.-Authors' abstract

01317 **Crosthwaite, E. G.** Water resources of the Salmon Falls Creek basin, Idaho-Nevada: U.S. Geol. Survey Water-Supply Paper 1879-D, p. D1-D33, illus., tables, 1969.

In the northern part of this basin surface water is inadequate to fully develop the good agricultural land. Ground water for domestic and stock use can be obtained everywhere, but is pumped for irrigation in only five areas. The Idavada Volcanics is the oldest water-bearing formation-dense thick Tertiary silicic flows and blankets of welded tuff, ash and clastic sediments. Fault zones and jointed rocks yield much water to wells, nonjointed masses little, and sand, tuff and ash moderate amounts. Younger vesicular porphyritic basalt flows and lenticular sedimentary interbeds, and fine-grained sediments in topographic lows, have various yields. Natural discharge flow is northward, perhaps 115,000 ac-ft annually; salinity is medium to high. In the upper basin to the south, used for grazing, most well water is obtained from Tertiary volcanics and tuffaceous sedimentary rocks.-GDC

07333 **Cunningham, Frank F.** The significance of Caribbean evidence in the elucidation of tors: Caribbean Jour. Sci., v. 8, nos. 3-4, p. 187-197, illus., 1968.

As joint-defined rock towers, tors are both angular and rounded with deep horizontal penetrations and various minor features. Many are of granite or coarse sandstone, but similar forms occur in a wide variety of rock types; projection causes vary with age and site. Theories of origin include differential subsurface tropical rotting, subaerial periglacial or tundra processes, and scarp recession with relict stacks. Some tors may be Tertiary initiated, but as subaerial forms evolving under fluctuating conditions: in cool areas sharpened by frost action, rounded in milder times, or in warm areas affected by amount of precipitation and base-level change. Evidence is ample for their present formation, for rejuvenation with or without climate change, and for preservation in Pleistocene glaciated areas. Tropical areas like Puerto Rico offer fields of study, but little significance is given saprolite corestones.-GDC

**Curran, H. Allen.** *See* Wheeler, Walter H. 01561

07188 **Curry, Robert Rodney.** Quaternary climatic and glacial history of the Sierra Nevada, California [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 29, no. 4, p. 1403B, 1968.

07159 **Dahlberg, Eric Charles.** A multivariate study of some aspects of trace metals in stream sediments as guides to locating mineral deposits [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 29, no. 3, p. 1109B, 1968.

**Dalrymple, G. Brent.** *See* Cox, Allan. 07330

**Daniel, T. W., Jr.** *See* Smith, W. E. 07268

01073 **Darlington, P. J., Jr.** A fossil carabid beetle from the Miocene of Montana: Michigan Univ. Mus. Paleontology Contr., v. 22, no. 14, p. 193-197, illus., 1969.

"Five specimens of fossil beetles from Miocene strata exposed in the Ruby Basin of Montana can only be identified as 'Carabid species (Harpalini?), Darlington 1968'." The specimens seem to represent a single species, but almost none of the diagnostic characters needed to show the insect's position within the Carabidae can be observed.-VMJ

07165 **Dash, Umakant.** Erosive behavior of cohesive soils [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 29, no. 3, p. 996B, 1968.

01518 **Davids, R. N.** Planktonic Foraminifera as apparent paleoclimate indicators in the latest Cretaceous [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 4, Southeastern Sec., p. 15-16, 1969.

01519 **Davies, Tudor T.** Chemistry and ultrastructure of some Atlantic mytiloid pelecypods [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 4, Southeastern Sec., p. 16, 1969.

01520 **Davies, Tudor T.** Diversity patterns of benthic invertebrates in Rappahannock River [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 4, Southeastern Sec., p. 16-17, 1969.

**Davis, Brian T. C.** *See* Bell, Peter M. 01277

**Decker, Edward R.** *See* Birch, Francis. 07259

**Deike, R. G.** *See* Randolph, J. R. 01302

**Deininger, Robert W.** *See* Bentley, Robert D. 01406

**DeMunter-Thompson, D. V.** *See* Manten, A. A. 07294

**Dence, M. R.** *See* Taylor, F. C. 01215

07168 **Denison, Robert H.** Middle Devonian fishes from the Lemhi Range of Idaho: Fieldiana-Geology, v. 16, no. 10, p. 269-288, illus., 1968.

The basal unit of the Jefferson Formation at the head of Spring Mountain Canyon, Lemhi County, Idaho, contained shield plates of: a heterostracan, *Psephaspis idahoensis*, n.sp., which is shown to belong to the Pteraspididae rather than the Drepanaspididae; the holonematid arthrodire *Holonema haiti*, n.sp., and undetermined arthrodires; an antiarch referred to Astrolepididae undet.; and a spine possibly belonging to a holocephalian. The depositional environment was possibly estuarine.-*from* Author's abstract

01521 **Dennen, W. H.; Blackburn, W. H.; Quesada, A.** Recognition of premetamorphic rock types by chemical studies [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 4, Southeastern Sec., p. 17, 1969.

**Dennen, W. H.** *See* Blackburn, W. H. 01528

**Dennis, C. L.** *See* Hilchie, D. W. 07281

01522 **Dennison, John M.; Boucot, Arthur J.** Little War Gap at Clinch Mountain has most nearly complete Devonian section in eastern Tennessee [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 4, Southeastern Sec., p. 17-18, 1969.

01178 **Denson, N. M.** New evidence on age relationships of possible Eocene rocks in southwestern North Dakota, *in* Geological Survey research 1969, Chap. B: U.S. Geol. Survey Prof. Paper 650-B, p. B63-B65, illus., 1969.

Stratigraphic studies in Morton, Billings, Golden Valley, Hettinger, Stark, and Slope Counties, southwestern North Dakota, indicate that generally accepted regional correlations of two stratigraphic units probably should be revised. First, a fine- to medium-grained sandstone previously correlated with the upper part of the Sentinel Butte Member of the Fort Union Formation of Paleocene age may actually be correlative with the Golden Valley Formation of early Eocene age. Second, the siliceous gray-green bentonitic siltstone and reddish brown claystone beds that unconformably overlie the Golden Valley(?) equivalent may actually be a hitherto unrecognized stratigraphic unit of late Eocene age rather than part of the White River Formation of Oligocene age as previously thought.-Author's abstract

01404 **Deslattes, Richard D.** Estimates of X-ray attenuation coefficients for the elements and their compounds, *in* Accurate determination of X-ray intensities and structure factors, Internat. Mtg., Cambridge, England, 1968: Acta Cryst., v. A25, pt. 1, p. 89-93, illus., 1969.

Some recent developments leading to improved knowledge of the distribution of oscillator strength in the photo-ionization continua of atoms are briefly reviewed. Selective comparisons between the experiments and calculations are indicated. Estimates for attenuation by compounds and solids, insofar as they depart from the mixture rule, require an understanding of X-ray fine structure or, at least, of its limiting form, which is not yet at hand. Some of the mechanisms leading to fine structure in solids and molecules are briefly reviewed.-Author's abstract

01408 **Dever, Garland R; McGrain, Preston.** Compositional variations in high-calcium limestone deposits in western Kentucky [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 4, Southeastern Sec., p. 19, 1969.

01248 **deWaard, D.** Reply [to "Analysis of equilibria involving garnet in rocks of granulite facies," by S. K. Saxena, 1969-Discussion of 1965 papers]: Am. Jour. Sci., v. 267, no. 4, p. 528-534, illus., table, 1969.

Charnokitic and granulitic rocks of the Varsberg region in Sweden contain mineral assemblages that are characteristic of the (hornblende)-clinopyroxene-almandine zone of the granulite facies. The three-fold division of the granulite facies: the (biotite)-cordierite-almandine zone, and the (hornblende)-clinopyroxene-almandine zone observed in the Adirondacks, represent metamorphic zoning of the Adirondack type, a sequence of progressive metamorphic changes characterizing the granulite facies of the Adirondack highlands. [See deWaard, Jour. Petrology, v. 6, p. 165-191, 1965; Am. Jour. Sci., v. 263, p. 455-461, 1965; Saxena, ibid., v. 267, p. 523-528, 1969.]-*from* Author's abstract

01398 **Dewey, James; Byerly, Perry.** The early history of seismometry (to 1900): Seismol. Soc. America Bull., v. 59, no. 1, p. 183-227, illus., 1969.

The earliest seismoscope was invented in A.D. 132 in China; others of limited effectiveness were known in the 18th century, and in the mid-19th century the times of small earthquakes were recorded. A successful low-sensitivity seismograph was invented in 1875. The first teleseismic recording was obtained in 1889. The Wiechert seismometer with viscous damping was introduced in 1898. Little theoretical work was done in the early days. The importance of tilt was much debated in the 1890's, and by 1900 many had become convinced that the effect of tilt on seismograph response could usually be neglected.-DBV

01374 **Dibaj, Mostafa; Penzien, Joseph.** Response of earth dams to traveling seismic waves: Am. Soc. Civil Engineers Proc., v. 95, paper 6453, Jour. Soil Mechanics and Found. Div., no. SM 2, p. 541-560, illus., table, 1969.

The finite element method, previously used assuming uniform base motion, is extended, and a general theory developed to account for spatial variations of ground motion along the dam base. The causes of these variations are discussed, and a theory which can be used for dynamic analysis of structures of any type subjected to known nonuniform base motion is presented. The method is demonstrated for a particular case, and results of analysis with different propagation velocities are presented as plots showing stress contours at selected instants of time and the time histories of stresses at selected points in the cross section. Results are compared with those for uniform base motion. Relative differences between the rigid base and traveling wave solutions are established, and it is shown that significant errors may be introduced by neglecting special variations in the ground motion.-*from* Authors' abstract

01409 **Dietrich, R. V.; Hall, M. R.; Ragland, P. C.** Differentiation within the Mount Airy "granite" [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 4, Southeastern Sec., p. 19-20, 1969.

01293 **Dilcher, David L.** *Podocarpus* from the Eocene of North America: Science, v. 164, no. 3877, p. 299-301, illus., 1969.

A few leafy gymnosperm shoots were found in Eocene deposits of southeastern North America. Similar fossil material from Tertiary deposits in North America has been identified as *Taxodium*, *Taxites*, and *Sequoia*. This new fossil material is not related to these genera but belongs to *Podocarpus* section *Stachycarpus*. This is the first fossil record of this section in North America.-Author's abstract

07257 **Diment, W. H.** Gravity anomalies in northwestern New England, Chap. 30 *in* Studies of Appalachian geology, northern and marine (Zen, E-an, and others, editors): New York and London, Interscience Publishers, p. 399-413, illus., 1968.

The gravity field of western New England is distinguished by a main north-south-trending gravity high flanked by western and eastern gravity lows. The axis of the main gravity high is nearly colinear with the axis of the Green Mountains anticlinorium in northern and central Vermont. To the south the gravity axis lies to the east of the structural axis. The western gravity low corresponds closely with the terrane of Paleozoic miogeosynclinal deposits of western New England and eastern New York. The eastern gravity low occurs on a terrane of eugeosynclinal deposits that are host to extensive granitic rocks. The western boundary of the main gravity high may mark a geosuture along which the crust and mantle on the east have been raised with respect to that on the west.-JWC

07339 **Dionne, Jean-Claude.** Morphologie et sédimentologie glacielles, littoral sud du Saint-Laurent [with German and English summ.], *in* Coastal geomorphology: Zeitschr. Geomorphologie, supp. 7, p. 56-84, illus., 1968.

The south shore of upper Maritime St. Lawrence Estuary shows the role of drift ice in littoral morphology and sedimentology. Shale platforms cut by tidal movement of sea-ice blocks have surface scratches with multiple orientation, shorter and more shallow than glacial striae. Icefoot protects the shore from wave erosion in winter; ice-push ridges and collapse structures, also pockets of mud and clay, are seen on beaches. Spring floes carry away great amounts of sediments, from mud to large boulders adhering to base or incorporated within ice, and the surface cover of rock falls, bank slumps, and fluvial sand and gravel. Deposits on lower beaches and tidal flats are heterogeneous, poorly sorted, and from crystalline rocks. Upper beach deposits are mostly sand and gravel, with large boulders 50 to 85 percent Laurentide in origin.-GDC

07243 **Dixon, H. Roberta; Lundgren, Lawrence W., Jr.** Structure of eastern Connecticut, Chap. 16 *in* Studies of Appalachian geology, northern and marine (Zen, E-an, and others, editors): New York and London, Interscience Publishers, p. 219-229, illus., table, 1968.

The Bronson Hill anticlinorium and the Merrimack synclinorium extend from New Hampshire through Massachusetts into eastern Connecticut. The Bronson Hill anticlinorium in Connecticut is comprised of the Monson and Glastonbury anticlines and the intervening Great Hill syncline; these culminate to the south in the Killingworth dome. Two major structural features are recognized in the Merrimack synclinorium: (1) a large recumbent syncline in the mica schists and calc-silicate gneisses that make up the synclinorium-it formed during the major phase of metamorphism and is overturned to the east; (2) a large thrust fault on the south and east of the synclinorium.-JWC

01334 **Dobbins, David Ashmun.** Sedimentary geochemistry and hydrogeochemistry of Pamlico River-Pamlico Sound estuary, North Carolina [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 29, no. 7, p. 2493B, 1969.

**Dodd, J. Robert.** *See* Fowler, Michael L. 01502

**Doell, Richard R.** *See* Cox, Allan. 07330

07240 **Doig, Ronald; Barton, Jackson M., Jr.** Ages of carbonatites and other alkaline rocks in Quebec: Canadian Jour. Earth Sci., v. 5, no. 6, p. 1401-1407, illus., table, 1968.

Potassium-argon ages have been determined for alkaline rocks, including carbonatites, from some fifteen localities in Quebec. Nine centers of intrusion, including two previously documented localities, yield ages in the range 400 to 600 m.y. All but two of these are located on or very near the northern boundary fault of the St. Lawrence graben system. Included in this group are four carbonatites with remarkably similar ages of intrusion (565 m.y.). The existence of this widespread coeval igneous activity along a 1200-mile segment of the lowland area and its westward extension supports the hypothesis that the St. Lawrence graben is a continuous structure, and indicates that the system has been active for at least 600 m.y.-Authors' abstract

**Dorman, James.** *See* Barazangi, Muawia. 01381

01075 **Dorr, John A., Jr.** Mammalian and other fossils, early Eocene Pass Peak Formation, central western Wyoming: Michigan Univ. Mus. Paleontology Contr., v. 22, no. 16, p. 207-219, illus., 1969.

A few mammalian fossils (briefly described but not figured) from several levels of the Pass Peak Formation well exposed in road-cut sections in Sublette County, Wyo., indicate that the formation is not middle Eocene (Bridgerian) in age, as interpreted by other authors from the unfossiliferous type section at Pass Peak, but early Eocene (Wasatchian). Ages of three faunules are probably: Late Graybullian (late Early Wasatchian) in a transition zone between the underlying Hoback Formation and the Pass Peak; Lysitean (mid-Wasatchian); Early Lostcabinian (early Late Wasatchian) near the eroded top of the formation. Strata exposed along the highway include fine clastics of a midbasin facies, in contrast to coarse conglomerates at the type locality. At least the upper part of the formation interfingers southward with the LaBarge tongue of the Wasatch Formation.-VMJ

**Drapeau, Georges.** *See* Stanley, Daniel J. 07340

01410 **DuBar, Jules R.; Howard, James F.** Paleoecology of the James City Formation (Plio-Pleistocene?), Neuse River Estuary, North Carolina [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 4, Southeastern Sec., p. 20, 1969.

01373 **Duncan, James M.; Dunlop, Peter.** Slopes in stiff-fissured clays and shales: Am. Soc. Civil Engineers Proc., v. 95, paper 6449, Jour. Soil Mechanics and Found. Div., no. SM 2, p. 467-492, illus., tables, 1969.

Case histories and probable causes of slope failures are reviewed, and analyses described which were performed to determine the influence of initial stress conditions on stresses around excavated slopes. Shear stresses around excavations are

much larger for heavily over-consolidated clays than for normally consolidated. Stresses large enough to cause failure may develop even when the factor of safety is much larger than unity. The higher the horizontal stresses before excavation, the higher the factor of safety corresponding to development of local failures.-*from* Authors' abstract

07153 **Duncan, John Russell, Jr.** Late Pleistocene and postglacial sedimentation and stratigraphy of deep-sea environments off Oregon [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 29, no. 3, p. 1063B-1064B, 1968.

**Dunlop, Peter.** *See* Duncan, James M. 01373

01384 **Dziewonski, A.; Block, S.; Landisman, M.** A technique for the analysis of transient seismic signals: Seismol. Soc. America Bull., v. 59, no. 1, p. 427-444, illus., 1969.

An analytical method, called the "multiple filter technique," is shown to be a fast and efficient means of studying multi-mode dispersed signals. Amplitudes and phases, as functions of period and velocity, are determined from the output of a set of narrow-band digital filters. The group velocities and other dispersion parameters determined by this technique are concordant with theoretical values when the method is tested with synthetic seismograms. It can recover broader portions of the dispersion present in ordinary seismic recordings compared to the classical peak and trough method. A simple diagnostic diagram is introduced in order to study the time and frequency resolution permitted by this analytic technique.-Authors' abstract

**Eakins, P. R.** *See* Clark, T. H. 07135

**Eddy, Greg E.** *See* Jones, Michael L. 01486

**Eden, William J.** *See* Crawford, Carl B. 01372

**Edmisten, Neil.** *See* Foster, Norman H. 07263

01254 **Eggler, D. H.; Larson, E. E.; Bradley, W. C.** Granites, grusses, and the Sherman erosion surface, southern Laramie Range, Colorado-Wyoming: Am. Jour. Sci., v. 267, no. 4, p. 510-522, illus., tables, 1969.

The Sherman erosion surface is developed principally on the Precambrian Trail Creek granite facies of the Sherman Granite. A distinctive petrographic characteristic of the Trail Creek granite is extensive, high-temperature oxidation of Precambrian age. Minerals so affected were principally the opaques and biotite. Later weathering processes exploited the oxidized biotites to produce vermiculite, montmorillonite, kaolinite, and gibbsite, all contributing to additional biotite expansion which has shattered the near-surface rock. Disintegration to gruss is so rapid and complete that outcrops are scarce, and a smooth, gently rolling topography results. Other crystalline rocks, lacking the early alteration, weather more slowly and selectively, providing the parkland-tor topography.-*from* Authors' abstract

01399 **Eisler, Joseph D.** Investigation of a method for determining stress accumulation at depth, [Pt.] 2: Seismol. Soc. America Bull., v. 59, no. 1, p. 43-58, illus., tables, 1969.

The second of two seismic field experiments designed to study the precision with which the arrival of compressional body waves could be timed over paths up to 42 km in length was performed seven months after the first at the same location in the Gabilan Range near Salinas, Calif. Results of the second experiment show that the timing of the compressional waves could be carried out to the same order of precision as in the first experiment, i. e. to ± 1 msec. In addition, the traveltimes over certain path lengths increased by about 6 msec within the intervening period. This observation is discussed in terms of the possible release of stress at depth in the region adjacent to the San Andreas fault.-Author's abstract

**Ekren, E. B.** *See* Armstrong, Richard L. 01250

**Elders, W. A.** *See* Grasty, R. L. 01229

01320 **Elders, W. A.; Rucklidge, J. C.** Rheomorphism of granite by gabbro intrusions on the coast of south-central Labrador: Jour. Geology, v. 77, no. 2, p. 240-244, illus., 1969.

Excellent exposures along the coast of Labrador for 150 km reveal a consistent pattern of thick gabbro sheets overlying migmatic granite gneisses. The relationship between the two rocks is complex, and in many places each appears to have intruded the other. However, mineralogical, textural, and structural criteria may be interpreted as showing that the gabbros are younger than the gneisses. An exceptional example illustrating these relations is described from Spotted Island. It is suggested that the heat of the intruding gabbro magma caused widespread mobilization of the granitic basement rocks.-Authors' abstract

01504 **Ellison, Robert L.** *Ammobaculites*-Foraminiferal proprietor of Chesapeake Bay estuaries [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 4, Southeastern Sec., p. 20-21, 1969.

01505 **Englund, Kenneth J.** Relation of the Pocahontas Formation to the Mississippian-Pennsylvanian systemic boundary in southwestern Virginia and southern West Virginia [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 4, Southeastern Sec., p. 21, 1969.

01274 **Ernst, W. G.; Calvert, S. E.** An experimental study of the recrystallization of porcelanite and its bearing on the origin of some bedded cherts: Am. Jour. Sci., v. 267-A (Schairer Volume), p. 114-133, illus., tables, 1969.

In the Monterey Formation of California, chert is at the base, overlain by porcelanite (fine-grained cristobalite), and diatomite toward the top; the biogenically precipitated silica has been progressively recrystallized from diatomite through porcelanite to chert. Hydrothermal experiments on the transformation of porcelanite to quartz show that the percentage of material recrystallized per unit time is constant. Extrapolation of the time required for complete conversion of porcelanite to quartz at 20°C in presence of pure water pore fluid indicates a period of 180 m.y. Chertification occurs in the formation along bedding planes and fractures where apparently alkaline aqueous fluids have been present for long periods of time; earlier work has shown that alkaline solutions speed up the reaction rate.-*from* Authors' abstract

**Evans, Clifford.** *See* Friedman, Irving. 07288

**Evans, L. L.** *See* McCormick, J. E. 01064

01391 **Ewald, P. P.** Introduction to the dynamical theory of X-ray diffraction, *in* Accurate determination of X-ray intensities and structure factors, Internat. Mtg., Cambridge, England, 1968: Acta Cryst., v. A25, pt. 1, p. 103-108, illus., 1969.

The general features, terminology, and method of the dynamical theory of X-ray diffraction are discussed, stressing the analogy with the general theory of small oscillations of a mechanical system.-Author's abstract

01063 **Fagan, James M.** Geology of the Lost Creek barite mine, *in* Papers on the stratigraphy and mine geology of the Kingsport and Mascot formations (Lower Ordovician) of East Tennessee: Tennessee Div. Geology Rept. Inv. 23, p. 40-44, illus., 1969.

The Lost Creek mine, in Union County, is developed on the dip slope in the upper few feet of the Lower Ordovician Mascot Dolomite and the lower 50 feet of the overlying Middle Ordovician Dot Formation. A collapse breccia body, about 150 feet in diameter, consists of fragments of the Dot in a matrix of dolomite, and barite occurs in the spaces between the breccia blocks, as coatings on the fragments, and as disconnected fragments in the matrix. Barite occurs in the breccia as filling and in fractures in the bedrock parallel to the peripheral edge of the collapse and dipping away at moderate to high angles. Rising mineralizing solutions filled the openings after collapse. Barite and pyrite are the main minerals. Solution of the underlying Kingsport caused the collapse of the overlying Dot.-HRC

01506 **Fass, Richard W.** Engineering properties of York River sediments [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 4, Southeastern Sec., p. 21-22, 1969.

**Faul, H.** *See* Lyons, J. B. 07250

**Feldhausen, Peter H.** *See* Park, Richard A. 01442

**Fellers, G. E.** *See* Hawkes, I. 01376

07144 **Feray, Dan E.; Oetking, Philip; Renfro, H. B.** (compilers). Pacific Southwest region, geological highway map, California-Nevada: Am. Assoc. Petroleum Geologists U.S. Geol. Highway Map Ser., no. 3, 2 sheets, scale about 1 in. to 30 mi., sections, text, 1968.

The first sheet contains generalized charts of time and rock units in the physiographic provinces of California and Nevada and eastern California, with explanatory notes. Sheet 2 includes inset tectonic and physiographic maps with brief explanations, a sequence of small maps that picture the geological history of the area in summary form, and four cross sections.-MCM

01507 **Ferm, John C.** Carboniferous paleogeography and continental drift [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 4, Southeastern Sec., p. 22, 1969.

**Ferrara, Giorgio.** *See* Bass, Manuel N. 01252

**Fidler, Richard E.** *See* Norris, Stanley E. 01198

01508 **Field, Michael E.** Deep-sea sands from the North Carolina continental margin [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 4, Southeastern Sec., p. 22-23, 1969.

07343 **Fischbuch, N. R.** Stratigraphy, Devonian Swan Hills reef complexes of central Alberta: Bull. Canadian Petroleum Geology, v. 16, no. 4, p. 444-556, illus., tables, 1968.

Six subsurface reef complexes in the Swan Hills area, rich in stromatoporoid and associated faunas, are easily correlated; nine separate stages of reef growth, from bottom to top, are designated Divisions I to IX of the Swan Hills Formation. Five of 31 recognized stromatoporoid species are new; dendroid forms are allied genetically to both subspherical and tabular forms. It is proposed that growth form be given little importance for taxonomic purposes. Progressive loss of species at end of each stage of reef growth is most significant between Divisions V and VI, where a break indicates a disconformity marking considerable lapse of time at the Middle-Late Devonian boundary. Diagnostic Middle Devonian ostracodes also disappear at this level, and no later Devonian was recovered above it. The enclosing Waterways Shale contains a Late Devonian microfauna.-GDC

01204 **Fischbuch, Norman R.** Devonian stromatoporoids from central Alberta, Canada: Canadian Jour. Earth Sci., v. 6, no. 1, p. 167-185, illus., 1969.

The Devonian Swan Hills reef complexes of western Canada contain a prolific and well-preserved stromatoporoid fauna. Species of the genera *Hermatostroma*, *Atelodictyon*, *Stromatopora*, *Parallelopora*, *Ferestromatopora*, and *Clathrocoilona* are common constituents of the reef, fore-reef, and reef platform limestones. Specimens from six reef complexes (Snipe Lake, Goose River, Kaybob, Virginia Hills, Swan Hills, and House Mountain) are described. Most species occur in several growth forms although one growth form is usually predominant. Two new species, *Clathrocoilona* sp. and *Stromatopora* sp., are recognized in the Swan Hills material.-Author's abstract

07189 **Fischbuch, Norman Robert.** Stratigraphy of the Devonian Swan Hills reef complexes of central Alberta [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 29, no. 4, p. 1403B-1404B, 1968.

07310 **Fischer, William A.** Orbital surveys of the Earth, *in* Use of space systems for planetary geology and geophysics-AAS Symposium, Boston, Mass., 1967, Proc.: Tarzana, Calif., Am. Astronaut. Soc. (AAS Sci. and Technology Ser., V. 17), p. 5-11, 1968.

An observer in a helicopter helps many of us reach our work each morning. By his observations and reports of traffic conditions and our reactions, we have "closed the loop of information". If such an observer is escalated to space and given orbital speed, he can effectively "close the loop" on resource problems of regional extent and dynamic nature, such as assessing the condition of range lands in the arid west. Small-scale observations, made from space, also help us to "zero in" on resource targets for more detailed study by aircraft or ground methods.-Author's abstract

**Flemer, David A.** *See* Biggs, Robert B. 01525

01509 **Folger, David W.** Characteristics of estuarine sediments of the United States-A synthesis [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 4, Southeastern Sec., p. 23, 1969.

**Foote, Leonard J.** *See* Meighan, Clement W. 07309

01510 **Forrest, Joe T.** Stratigraphy and structure of the Murphy Belt in the Murphy, North Carolina 7 1/2 quadrangle [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 4, Southeastern Sec., p. 23-24, 1969.

**Foster, J. B.** *See* Musgrove, R. H. 07299

07263 **Foster, Norman H.; McEachin, W. D.; Edmisten, Neil; Murray, D. Keith.** Type and typical stratigraphic sections of Colorado-Pt. F, Mississippian, *in* Guidebook issue, southeastern Colorado: Mtn. Geologist, v. 5, no. 3, p. 115-126, illus., 1968.

To provide standards for ready reference, surface and subsurface type and typical stratigraphic sections of the Mississippian System in various parts of Colorado are described herein. Locations of the sections are plotted on an isopachous map of the Mississippian. The use of the terms Madison Limestone in northwestern and northeastern Colorado, Redwall Limestone in the southwestern portion of the state, Leadville Limestone in the outcrop areas of central Colorado and various Mid-Continental terms in southeast Colorado is suggested. [This is the first of a planned series by the Colorado Type Sections Subcommittee of the Rocky Mtn. Assoc. Geologists Research Committee. Reports on other Paleozoic Systems and Mesozoic and Tertiary sections will be published in succeeding issues.]-Authors' abstract

01273 **Foster, W. R.; Lin, H. C.** Studies in the system $BaO$-$Al_2O_3$-$SiO_2$-[Pt.] 2, The binary system celsian ($BaAl_2Si_2O_8$)-silica ($SiO_2$): Am. Jour. Sci., v. 267-A (Schairer Volume), p. 134-144, illus., table, 1969.

The results of quenching experiments on selected mixtures on the $BaAl_2Si_2O_8$-$SiO_2$ join of the $BaO$-$Al_2O_3$-$SiO_2$ system are presented. A simple eutectic system is shown to exist between the two end members, the eutectic point being located at 1311 ± 4°C and at a composition of 51 percent $BaAl_2Si_2O_8$ and 49 percent $SiO_2$. The complex relations between celsian and silica reported in earlier investigations have not been confirmed. Unlike the latter, thepresent results are in full accord with the coexistence of celsian and quartz in natural mineral occurrences.-Authors' abstract

01411 **Fountain, Richard C.** Theoretical density technique for the evaluation of central Florida phosphate matrix [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 4, Southeastern Sec., p. 24, 1969.

01502 **Fowler, Michael L.; Dodd, J. Robert.** Magnesium and strontium variation within echinoid skeletons [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 4, Southeastern Sec., p. 24-25, 1969.

01503 **Franco, Horacio A.** Florida phosphates process metallurgy [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 4, Southeastern Sec., p. 25, 1969.

**Franke, O. L.** *See* Cohen, Philip. 01347

**Frarey, M. J.** *See* Robertson, J. A. 01227

01213 **Fraser, J. A.; Tremblay, L. P.** Correlation of Proterozoic strata in the northwestern Canadian Shield: Canadian Jour. Earth Sci., v. 6, no. 1, p. 1-9, illus., table, 1969.

The Epworth and Goulburn Groups, in the Slave Province of the Canadian Shield, are studied. Each group is at least 4,600 m thick and underlies an area of not less than 13,000 sq km. Many features show the two groups to be correlative: each lies unconformably on Archean basement and is overlain unconformably by kaolinitic sandstone, by dolomite, and by Coppermine River basalt and sediments; each has argillite and quartzite near the base, interbedded argillite and limestone in the upper parts, and sandstone at the top; each is a shallow water deposit; both occupy similar structural basins and show similar folding and faulting; and both are cut by gabbro dikes and sills of similar age. Field data define these two groups as of Aphebian age.-*from* Authors' abstract

**Freda, G. N.** *See* Pearce, G. W. 01232

01501 **Frey, Robert W.; Cowles, John.** New observations on the trace fossil *Tisoa* Serres [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 4, Southeastern Sec., p. 25-26, 1969.

07288 **Friedman, Irving; Evans, Clifford.** Obsidian dating revisited [discussion of paper by C. W. Meighan, L. J. Foote, P. V. Aiello, 1968]: Science, v. 162, , no. 3855, p. 813-814, 1968.

In a recent paper, Meighan, Foote, and Aiello (ibid., v. 160, no. 3832, p. 1069-1075, 1968) use a linear rate of hydration (years per micron) in obsidian dating of western Mexican artifacts. On both experimental and empirical grounds, a rate of 20 $\mu^2$ per 1,000 yr seems more reasonable. Applying this rate yields a time span for the site in question which includes a radiocarbon date of A.D. 1300, which Meighan and his colleagues reject as being made on material intrusive to the site. They do not consider the possibility of reuse of artifacts, demonstrated to have occurred elsewhere. By rejecting data that do not fit their hypothesis they not only violate the principles of scientific investigation, but overlook potentially significant interpretations of archeology.-DBV

01412 **Fullagar, Paul D.** Whole-rock rubidium-strontium ages of the Liberty Hill pluton, South Carolina, and the Salisbury pluton, North Carolina [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 4, Southeastern Sec., p. 26, 1969.

01492 **Fullagar, Paul D.; Bottino, Michael L.** Rubidium-strontium age study of Middle Devonian Tioga Bentonite [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 4, Southeastern Sec., p. 27, 1969.

**Fulweiler, R. E.** *See* Crawford, Johnson. 01066

01403 **Furnas, Thomas C., Jr.** Error evaluation *versus* 'on line' correction, *in* Accurate determination of X-ray intensities and structure factors, Internat. Mtg., Cambridge, England, 1968: Acta Cryst., v. A25, pt. 1, p. 76-81, illus., 1969.

Crystallographers have enjoyed a freedom of access to computers that cannot continue. In spite of widespread pressures to automate experiments, computers are not a substitute for proper experimental technique. As a group, crystallographers are remarkably naive not only regarding the evaluation or comparison of the experimental and computational techniques which they employ, but also regarding the actual cost and value of their efforts. Some concerted thought, effort and self-education must be undertaken soon lest extravagance endanger future support.-Author's abstract

01234 **Fyfe, W. S.** Some second thoughts on $Al_2O_3$-$SiO_2$: Am. Jour. Sci., v. 267, no. 3, p. 291-296, illus., 1969.

Consideration of the complex factors involved in the andalusite-sillimanite transition and the small $\Delta S$ of reaction indicate that solubility methods may be suitable for find-

ing transition points. Comparison of aqueous solubilities of the polymorphs can also provide information on the degree of polymerization of silica solutions.-Author's abstract

07277 **Gardner, G. H. F.; Harris, M. H.** Velocity and attenuation of elastic waves in sands, *in* SPWLA Logging Symposium, 9th Ann., New Orleans, La., 1968, Trans: Houston, Tex., Soc. Prof. Well Log Analysts, p. M1-M19, illus., 1968.

The dependence of P- and S-wave velocities on differential pressure, porosity, and fluid content in poorly consolidated formations is presented numerically in a series of charts. Sonic logs for unconsolidated formations appear to show a reduction in amplitude and velocity for both P- and S-waves when the sands contain hydrocarbons as compared with the similar sands containing water. Laboratory experiments demonstrate that P-wave velocity is sensitive to the compressibility of the fluid that saturates a sand, whereas S-wave velocity is not. On the other hand, P-wave attenuation is not sensitive to the saturating fluid whereas S-wave attentuation in certain circumstances is.-KAF

**Gast, P. W.** *See* Oversby, V. M. 07303

**Gaudette, Henri E.** *See* Anderson, Franz E. 01537

**Gearhart, Marvin.** *See* Hawkins, William K. 07284

01400 **Gedney, Larry; Berg, Eduard.** The Fairbanks earthquakes of June 21, 1967-Aftershock distribution, focal mechanisms, and crustal parameters: Seismol. Soc. America Bull., v. 59, no. 1, p. 73-100, illus., tables, 1969.

Following a series of moderately severe earthquakes near Fairbanks, Alaska, on June 21, 1967, many thousands of aftershocks were recorded to outline the aftershock zone and to resolve the focal mechanism and its relation to the regional tectonic system. Foci occupy a relatively small volume in the shape of an oblate cylinder tilted about 30° from the vertical with depths from near-surface to 25 km although most were in the range 9-16 km. The Jeffreys-Bullen velocity of 5.56 kmps for the P-wave in the upper crust is very near the true value for this area, and use of 1.69 for the $V_p/V_s$ ratio gives good results in most cases. The proposed faulting mechanism involves nearly equal components of right-lateral strike slip, and normal faulting with northeast side downthrown on a system of sub-parallel faults striking N. 40° W. The fault surface dips from near vertical close to the surface to less steep northeast dips at greater depths.-*from* Authors' abstract

01230 **Gees, Rudolf A.; Lyall, Anil K.** Erosional sand colums in dune sands, Cape Sable Island, Nova Scotia, Canada: Canadian Jour. Earth Sci., v. 6, no. 2, p. 344-347, illus., 1969.

Miniature sand columns eroded into crossbedded dune sands are described. Apparently the columns formed after the spring thaw by wind and water erosion.-Authors' abstract

07328 **Gerasimovskiy, V. I.; Stupnikova, N. I.; Zykov, S. I.** O vozraste intruziy Ilimaussak i Igaliko Gardarskoy provintsii (Yu-Z. Grenlandiya): Geokhimiya 1968, no. 9, p. 1134-1136, table, 1968.

Results of lead isotopic analysis of galena from the Ilimaussaq massif and of zircon from a pegmatite of the Igaliko intrusion in southwestern Greenland show that the former is 1,000-1,200 m.y. old and the latter 1,150 ± 100 m.y. old. On the basis of this and earlier-published data, it is evident that the whole Gardar intrusion belongs to the Middle Gardar formation, which is 1,050-1,180 m.y. old.-DBV

07262 **Gerhard, Lee C.** Pre-Pennsylvanian sediments, Canon City embayment, Colorado, *in* Guidebook issue, southeastern Colorado: Mtn. Geologist, v. 5, no. 3, p. 109-114, illus., geol. map, 1968.

The Canon City embayment of Colorado has had a varied structural and sedimentation history, including several periods of vertical structural reversal. Several structural units are recognized within the embayment. Some have had pre-Laramide movements, recorded in the lithology and thickness of the sedimentary rocks of the Paleozoic. Sediments of Ordovician, Devonian, Pennsylvanian, Permo-Triassic, Jurassic and Cretaceous age are exposed in the embayment in such a way that they may be studied essentially in three dimensions. Application of the history of this area to the southeastern Colorado region may provide Paleozoic exploration targets for the petroleum geologist.-Author's abstract

07266 **Gerhard, Lee C.; Mark, Anson.** First day's road log-Southwest from Pueblo to northeast flank of Wet Mountains; study of Paleozoic and Mesozoic section from Beulah to Canon City area; return to Pueblo, *in* Guidebook issue, southeastern Colorado: Mtn. Geologist, v. 5, no. 3, p. 154-164, illus., 1968.

This is the first of a two-day field conference of the Rocky Mountain Association of Geologists, held in conjunction with the 1968 Symposium, Petroleum potential of southeast Colorado. Note is made with brief descriptions of geology to be seen along the 161-mile route, and at seven of the ten stops. Photographs show outcrops of the Hardscrabble Formation (Mississippian) near Beulah, and a contact of Ordovician Harding Sandstone and Precambrian metamorphics at Grape Creek.-GDC

01323 **Gibbon, D. L.; Wyllie, P. J.** Experimental studies of igneous rock series-The Farrington Complex, North Carolina, and the Star Mountain Rhyolite, Texas: Jour. Geology, v. 77, no. 2, p. 221-239, illus., tables, 1969.

Four samples from each rock mass, ranging from granite to tonalite, were investigated at 1 to 3 kb in 15 to 20 weight percent $H_2O$, locating *PT* curves for initiation and completion of melting of quartz and the feldspars. Results help to establish primary phase volumes in the "Granodiorite Tetrahedron". Failure to reproduce the peculiar textural features of the original Star Mountain Rhyolite is believed due at least in part to the markedly higher water content under experimental conditions.-REW

**Gibbs, G. V.** *See* Ribbe, P. H. 01430

**Gibbs, G. V.** *See* Novak, G. A. 01460

01493 **Gibbs, G. V.; Ribbe, P. H.** Distortions of coordination polyhedra in norbergite [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 4, Southeastern Sec., p. 27, 1969.

**Gibbs, G. V.** *See* Brown, G. E. 01512

01267 **Gilbert, M. C.** High-pressure stability of acmite: Am. Jour. Sci., v. 267-A (Schairer Volume), p. 145-159, illus., tables, 1969.

Acmite, $NaFe^{3+}Si_2O_6$, continues to melt incongruently to hematite + liquid up to at least 45 kb. The equation $T(°C) = 988 + 20.87P\ (kb) - 0.155P^2(kb)$ reproduces the fusion curve for acmite = hematite + liquid over the pressure range 0 to 45 kb. The initial slope of this curve is about 20°C/kb, which is steep for silicates. An acmitic pyroxene may be stable in equilibrium with metallic iron. Under conditions of low relative oxygen fugacity, acmite melts incongruently to fayalite + liquid. Acmite and some other silicates do not exhibit a linear relation between melting temperature and compressibility and therefore do not obey the recently proposed "new law of melting".-Author's abstract

**Gilbert, M. C.** *See* Richardson, S. W. 01338

01494 **Gilbert, M. C.; Wones, D. R.** The upper $f_{O_2}$ stability of fayalite [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 4, Southeastern Sec., p. 27-28, 1969.

**Gilbert, M. Charles.** *See* Wones, David R. 01279

07211 **Gilliland, J. A.; Treichel, A.** GOWN-A computer storage system for groundwater data: Canadian Jour. Earth Sci., v. 5, no. 6, p. 1518-1524, illus., 1968.

GOWN is intended to be a tool to assist the scientist and manager. Design of the system emphasizes flexibility, utility, and compatibility. GOWN is a computer-operated data-processing system using magnetic tape as the basic storage medium. The programs to create well-log, well-data, and catalog files have been developed and other files can be added as needed. Extensive use of parameter codes and mnemonic codes is made, enabling data from a variety of sources to be handled. A library of retrieval routines will be developed so that data can be presented as graphs, maps, or sections. It is anticipated that GOWN will substantially increase the efficiency of the scientist by relieving him of the load of routine data manipulation.-Authors' abstract

**Givens, W. W.** *See* Hilchie, D. W. 07281

07238 **Globensky, Yvon.** Scolecodonts from the Windsor Group (Mississippian) of Nova Scotia: Canadian Jour. Earth Sci., v. 5, no. 6, p. 1397-1400, illus., table, 1968.

The first discovery of scolecodonts (worm jaws) from the insoluble residues of limestones from the Windsor Group (Valmeyeran-Chesterian) of Nova Scotia is represented by 8 genera. The genera *Lumbriconereites* and *Stauronereisites* are restricted to Subzone E. Scolecodonts are absent from the Lower Windsor strata.-Author's abstract

07166 **Goel, Subhash Chandra.** Inelastic behavior of multistory building frames subjected to earthquake motions [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 29, no. 3, p. 996B, 1968.

**Golden, H. G.** *See* Turner, J. D. 07141

**Golden, H. G.** *See* Newton, J. G. 07269

01261 **Goldsmith, Julian R.; Newton, Robert C.** P-T-X relations in the system $CaCO_3$-$MgCO_3$ at high temperatures and pressures: Am. Jour. Sci., v. 267-A (Schairer Volume), p. 160-190, illus., tables, 1969.

Tests in the 400 to 800°C range and 1 to 25 kb pressure revealed no clear-cut transition between calcite I and II when examined by DTA, microscopic texture analysis, and $MgCO_3$ solubility measurements in the calcites. The effect of the $MgCO_3$ on the location of the calcite-aragonite boundary was determined. The effect of total pressure on the solubility of $MgCO_3$ in the calcite structure was calculated by a regular solution theory and the theory reinforces the experimental determination. It is concluded that the calcite-dolomite solvus can be a very useful geothermometer for metamorphic calcite, especially if the depth of the metamorphism can be categorized as shallow, intermediate, or deep.-*from* Authors' abstract

**Goodell, H. G.** *See* Ryan, John J. 01424

01495 **Goodell, H. G.** The Wisconsin estuarine history along the northwest Florida coast [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 4, Southeastern Sec., p. 28, 1969.

07190 **Goodspeed, Robert Marshall.** An investigation of the coexisting feldspars from the Precambrian plutonic rocks in the Wanaque area, New Jersey [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 29, no. 4, p. 1404B-1405B, 1968.

07181 **Goss, Don Woodson.** Mica weathering as related to mica species and soil parent material in the North Carolina Slate Belt [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 29, no. 4, p. 1233B, 1968.

07278 **Granberry, Raymond J.; Jenkins, Ralph E.; Bush, Darrell C.** Grain density values of cores from some Gulf Coast formations and their importance in formation evaluation, *in* SPWLA Logging Symposium, 9th Ann., New Orleans, La., 1968, Trans: Houston, Tex., Soc. Prof. Well Log Analysts, p. N1-N19, illus., tables, 1968.

Analysis of sands from the Gulf Coast, South Texas, and the Ark-La-Tex area indicates that the grain densities are sensitive to the state of hydration of the clays in the sands. The shaly Miocene and Frio rocks generally have low grain density values, which will cause an evaluation of reservoir volume to be erroneously optimistic when assuming a grain density of 2.65 g per cc. High permeability or clean Miocene and Frio rocks and Sparta sand have grain density values in good agreement with the usually assumed value of 2.65 g per cc. The Wilcox formation has grain density values of about 2.67 and 2.69 g per cc in productive intervals. The Navarro Group sands have much hydratable clay, causing grain densities to range from 2.58 to 2.63.-KAF

01496 **Grant, Willard H.** The intrusion mechanics and cooling history of Stone Mountain granite [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 4, Southeastern Sec., p. 28-29, 1969.

01229 **Grasty, R. L.; Rucklidge, J. C.; Elders, W. A.** New K-Ar age determinations on rocks from the east coast of Labrador: Canadian Jour. Earth Sci., v. 6, no. 2, p. 340-344, illus., table, 1969.

In a search for Tertiary dikes, rocks were collected along part of the east coast of Labrador. K-Ar age determinations on some of these rocks suggest that the Grenville Front passes out to sea along the north side of Groswater Bay.-Authors' abstract

**Grasty, Robert.** *See* Milton, Charles. 01452

**Gray, C. H., Jr.** *See* Chesterman, Charles W. 01240

07246 **Green, John C.; Guidotti, Charles.** The Boundary Mountains anticlinorium in northern New Hampshire and northwestern Maine, Chap. 19 *in* Studies of Appalachian geology, northern and marine (Zen, E-an, and others, editors): New York and London, Interscience Publishers, p. 255-266, illus., 1968.

The area under consideration includes the core and northwest flank of the Boundary Mountains anticlinorium and, to the northwest, the first synclinal axis (Frontenac) syncline of the regional Connecticut Valley-Gaspe synclinorium. The core of the anticlinorium is composed of a complex series of Cambro-Ordovician rocks with local unconformable outliers of Silurian metasediments. The rocks of the synclinorium are predominantly Devonian, resting unconformably (Taconic unconformity) on Ordovician formations. At least three periods of intrusive activity are represented by plutonic rocks in the area. The stratified rocks of the entire area have been regionally metamorphosed; the grade increases from the chlorite zone on the northwest to the upper sillimanite zone on the southeast.-JWC

01378 **Greenfield, Roy J.; Sheppard, Robert M.** The Moho depth variations under the LASA and their effect on $dT/d\Delta$ measurements: Seismol. Soc. America Bull., v. 59, no. 1, p. 409-420, illus., table, 1969.

The LASA array in Montana was used to measure the slope of the traveltime curve ($dT/d\Delta$) for events with epicenters to the northwest and southeast. Lateral inhomogeneities under the array introduce large relative arrival time errors (station residuals). A model for the crust under LASA is proposed which can explain the station residuals. This crustal model accounts for the major differences between the measured and Jeffreys-Bullen $dT/d\Delta$ values. The model was used to correct the measured $dT/d\Delta$ profiles for the crustal effect.-Authors' abstract

01497 **Griffin, Villard S., Jr.** Structure of the Inner Piedmont Belt along the Blue Ridge physiographic front north of Walhalla, South Carolina [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 4, Southeastern Sec., p. 29, 1969.

01181 **Grigg, Neil S.; Rathbun, R. E.** Hydraulic equivalence of minerals with a consideration of the reentrainment process, *in* Geological Survey research 1969, Chap. B: U.S. Geol. Survey Prof. Paper 650-B, p. B77-B80, illus., 1969.

The concept of hydraulic equivalence has evolved to mean that grains having equal fall velocity tend to be of equivalent hydraulic value. However, calculations based on standard fall-velocity relations and Shields' criterion for critical shear stress suggest that grains having the same fall velocity but different specific gravities will require different shear stresses for initiation of motion. These calculations suggest for grains moving in traction, subject to continuous deposition and reentrainment, that equal fall velocity alone should not be a sufficient criterion to assure that the grains will be of equivalent hydraulic value.-Authors' abstract

07207 **Griscom, Andrew; Bromery, Randolph W.** Geologic interpretation of aeromagnetic data for New England, Chap. 32 *in* Studies of Appalachian geology, northern and marine (Zen, E-an, and others, editors): New York and London, Interscience Publishers, p. 425-436, illus., 1968.

Aeromagnetic features in southeastern Connecticut reveal a distinct east-west lineament that does not coincide with any mapped geologic unit or structure. In western New Hampshire, data indicate that the Oliverian gneiss domes extend eastward beneath nonmagnetic rocks. Plutonic rocks of the White Mountain batholith and adjacent stocks do not display magnetic anomalies, but other stocks and ring dikes give rise to anomalies that provide considerable information on subsurface structure. Profiles across the western flank of the Green Mtn. anticlinorium show the dip of the Paleozoic-Precambrian contact. Between the Adirondack Mts. and southwestern Vermont, anomalies are probably caused by Precambrian rocks beneath Cambrian and Ordovician sediments. Magnetic and gravity maps of Cape Cod reflect geology beneath the sedimentary cover; broad anomalies in northern Maine reflect disturbing masses at depths of several miles.-JWC

**Guidotti, Charles.** *See* Green, John C. 07246

07191 **Guldenzopf, E. Charles.** Champlainian biostratigraphy in northern Michigan [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 29, no. 4, p. 1405B, 1968.

07311 **Haag, Robert M.** The lithosphere-The solid state of matter, *in* Use of space systems for planetary geology and geophysics-AAS Symposium, Boston, Mass., 1967, Proc.: Tarzana, Calif., Am. Astronaut. Soc. (AAS Sci. and Technology Ser., V. 17), p. 119-123, 1968.

The mechanical, electrical, magnetic, and thermal properties of solid matter are discussed briefly and their origin and interrelations are considered in the light of the structure of solids. Inferences that may be drawn concerning the nature of the interior of the Earth and of the Moon and planets from solids observed at the surface of the Earth are suggested.-VSN

**Hadley, Jarvis B.** *See* Zen, E-an. 07177

07319 **Hails, John R.; Hoyt, John H.** Barrier development on submerged coasts-Problems of sea-level changes from a study of the Atlantic coastal plain of Georgia, U.S.A. and parts of the East Australian coast [with German and French abs.], *in* Coastal geomorphology: Zeitschr. Geomorphologie, supp. 7, p. 24-55, illus., tables, 1968.

The theory of barrier island development supported by this study is based on the following sequence: a dune or beach ridge forms adjacent to shoreline; submergence partially inundates the ridge; islands may prograde, erode, or remain stationary; lagoonal or inter-barrier width depends on height of submergence, slope of sea floor, rate of sedimentation and other factors. Pleistocene barriers elevated in Georgia show a transgressive relation with lagoonal-marsh sediments, compared to Australia's rugged bedrock shore. Offshore stages reported have been minor or short-lived features; landward, no extensive beaches are indicated. Geologic age of Georgia's shorelines lacks agreement; five radiocarbon dates on shells in the Silver Bluff sediments range from 25,000 to 36,000 yr; 6 infinite dates indicate submergence begun over 40,000 years ago. Caution is stressed in worldwide correlations.-GDC

**Hajnal, Zoltan.** *See* Hall, Donald H. 01200

01200 **Hall, Donald H.; Hajnal, Zoltan.** Crustal structure of northwestern Ontario-Refraction seismology: Canadian Jour. Earth Sci., v. 6, no. 1, p. 81-99, illus., tables, 1969.

Deep seismic sounding from 49°30′ to 51°30′ N. and from 93° to 96° W. shows a two-layered crust, with laterally and vertically uniform velocities. The discontinuity between them, called the Intermediate discontinuity, is believed to be similar to the Conrad. Contour maps of depths to this discontinuity and to the M-discontinuity show an average depth to the intermediate of 18.25 km and to the M-discontinuity, 34.28 km. Average surface elevation is 0.33 km. The vertical velocity over the area has a mean value of 6.36 kmps. Structures on the discontinuities are related to at least one major surface geological feature. A method called the station-pair method was devised and is recommended for interpretation of seismic refraction surveys.-*from* Authors' abstract

**Hall, Donald H.** *See* McGrath, Peter H. 01201

07298 **Hall, Donald H.** A magnetic interpretation method for calculating body parameters for buried sloping steps and thick sheets: Geoexploration, v. 6, no. 4, p. 187-206, illus., 1968.

A method is developed for application of a rapid digital computer to interpretation of magnetic anomalies over buried steps and sheets. The method is consistent with predetermined ranges of the body parameters and base level; the ability of the method to use this independent information is illustrated by treatment of a regional aeromagnetic anomaly and a residual aeromagnetic anomaly in the Kenora District, Ontario.-VSN

07130 **Hall, Leo M.** Times of origin and deformation of bedrock in the Manhattan Prong, Chap. 8 *in* Studies of Appalachian geology, northern and marine (Zen, E-an, and others, editors): New York and London, Interscience Publishers, p. 117-127, illus., 1968.

The metamorphic rocks in the Manhattan Prong of southeastern New York comprise an ancient basement of Yonkers and Fordham Gneisses overlain by metasedimentary Lowerre Quartzite, Inwood Marble, and Manhattan Schist; all have been subjected to sillimanite-grade metamorphism. The Fordham, Inwood, and Manhattan are divided into several lithologic subdivisions, which can be mapped and used to elucidate structure. Southeast of this terrane is the Hartland Formation, a metasedimentary unit also metamorphosed to the sillimanite zone. At least three separate pre-Mesozoic episodes of deformation took place in the Manhattan Prong. The earliest, involving intense folding and metamorphism, was Precambrian; the second, which was mild, was Middle Ordovician; the third, an extremely intense episode, was during or after Middle Ordovician.-JWC

**Hall, M. R.** *See* Dietrich, R. V. 01409

07208 **Halstead, E. Carl.** The Cowichan ice tongue, Vancouver Island: Canadian Jour. Earth Sci., v. 5, no. 6, p. 1409-1415, illus., 1968.

The sequence of late glacial deposits within Cowichan Valley and on Saanich Peninsula, Vancouver Island, British Columbia, suggests the existence of an ice tongue that occupied Cowichan Valley and extended eastward to Saanich Peninsula prior to the merging with and being overridden by Cordilleran ice of the last major glaciation. Following the maximum advance of Cordilleran ice, continuous melting and downwasting prevailed, but before deglaciation was complete, remanent ice in Cowichan Valley was rejuvenated. Similar glacio-climatic events have been recognized elsewhere in the Strait of Georgia, and are named the Evans Creek Stade, the Vashon Stade, and the Sumas Stade of the Fraser glaciation. The writer tentatively applies these names to the events on Vancouver Island.-Author's abstract

01393 **Hamilton, Walter C.** Comparison of X-ray and neutron diffraction structural results-A study in methods of error analysis, *in* Accurate determination of X-ray intensities and structure factors, Internat. Mtg., Cambridge, England, 1968: Acta Cryst., v. A25, pt. 1, p. 194-204, tables; discussion, p. 204-206, 1969.

Systematic error in crystallographic experiments and in crystal structure refinement models is discussed. Statistical methods for testing significance of the difference between parameters derived in two crystallographic experiments, applied to existing neutron and X-ray diffraction data on hydroxy-apatite and several compounds, show that there are strong systematic differences in thermal parameters for heavy atoms and in all parameters for hydrogen atoms. The pattern of results strongly suggests that differences between neutron and X-ray experiments have some physical basis rather than being due entirely to systematic error. Position parameters and root-mean-square amplitudes of vibration may be determined precisely in structures with a moderate number of atoms in the asymmetric unit.-*from* Author's abstract

01337 **Hammond, Weldon W., Jr.** Ground-water resources of Matagorda County, Texas: Texas Water Devel. Board Rept. 91, 173 p., illus., tables, geol. map, 1969.

The surface of Matagorda County is largely a depositional plain of the Beaumont Formation which was deposited by streams as a series of coalescing alluvial and deltaic plains. Ground water occurs in several Quaternary formations of similar lithology-interfingering beds and lenses of silt, clay, sand, and gravel-which function as the Gulf coast aquifer. Use of ground water has increased from 14 mgd in 1946 to 17 mgd in 1966. Water levels in wells are gradually declining in the western part, but present pumping could be continued safely and economically indefinitely. Fresh ground water is available in most sections and slightly saline water throughout the county. A comprehensive program to monitor changes in quantity and quality should be established.-*from* Author's abstract

01498 **Haney, Donald C.; Smith, James W.** Re-entrant in the Saltville fault near Rogersville, Tennessee [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 4, Southeastern Sec., p. 29-30, 1969.

01332 **Hanna, William F.** Gravity and magnetic contrasts between the western Franciscan and Salinian basement terranes, southwestern California [abs.]: EOS (Am. Geophys. Union Trans.), v. 50, no. 4, p. 321, 1969.

01238 **Hanson, C. Bruce.** Individual variation and evolutionary change in the dentition of *Hyracodon* [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 3, Cordilleran Sec., p. 22, 1969.

01499 **Hare, P. E.** Composition of the organic matrix of some invertebrate calcified structures [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 4, Southeastern Sec., p. 30, 1969.

**Harrell, William W.** *See* Parker, Robert H. 01417

01062 **Harris, Leonard D.** Kingsport Formation and Mascot Dolomite (Lower Ordovician) of East Tennessee, *in* Papers on the stratigraphy and mine geology of the Kingsport and Mascot formations (Lower Ordovician) of East Tennessee: Tennesse Div. Geology Rept. Inv. 23, p. 1-39, illus., 1969.

The upper Knox Group is readily divisible into two major lithologic sequences: (1) a limestone and a medium to coarsely crystalline dolomite overlain by (2) a very fine crystalline dolomite. The previous three-fold division-Longview, Kingsport, and Mascot Dolomite- is abandoned and the Kingsport and Mascot formations are redefined to include the above two major divisions, respectively. Chert is present in both formations and its abundance is directly related to sedimentary and later processes. Penecontemporaneous, but not primary, chert is abundant. Chert-replaced stromatolites form up to 35 percent of the Kingsport and 25 percent of the Mascot. A field trip log for study of breccia bodies at the Kingsport-Mascot contact and the accompanying zinc mineralization is appended.-HRC

**Harris, M. H.** *See* Gardner, G. H. F. 07277

**Harriss, Robert C.** *See* Macdougall, J. Douglas. 01225

01470 **Harriss, Robert C.; Williams, Harold H.** Uptake of Cl, Br, and F in marine and nonmarine calcareous skeletal material [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 4, Southeastern Sec., p. 31, 1969.

01500 **Harriss, Robert C.** Controls of the boron content of the oceans [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 4, Southeastern Sec., p. 30, 1969.

**Harriss, Robert C.** *See* Alberts, James. 01536

07131 **Hatch, Norman L., Jr.; Schnabel, Robert W.; Norton, Stephen A.** Stratigraphy and correlation of the rocks on the east limb of the Berkshire anticlinorium in western Massachusetts and north-central Connecticut, Chap. 13 *in* Studies of Appalachian geology, northern and marine (Zen, E-an, and others, editors): New York and London, Interscience Publishers, p. 177-184, illus., 1968.

The stratified rocks in north-central Connecticut and southwestern Massachusetts between the Berkshire Highlands on the west and the Triassic basin on the east have been separated into eight units, which are designated Unit 1 through Unit 8 successively up the section. These units are correlated with the reasonably well dated section of northwestern Massachusetts as follows: Unit 1 with the Early Cambrian Hoosac Formation; Unit 2 with the Cambrian Rowe Schist; Unit 3 with the Middle Ordovician Moretown Formation; and Units 4 and 5 with the Middle Ordovician Hawley Formation. Units 6, 7, and 8 have no known equivalents in northern Massachusetts.-JWC

01471 **Hatcher, Robert D., Jr.** Stratigraphy and petrology of the Brevard-Poor Mountain-Henderson belt of northwest South Carolina [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 4, Southeastern Sec., p. 31, 1969.

01472 **Hatcher, Robert D., Jr.** Structure of the low rank belt of northwest South Carolina [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 4, Southeastern Sec., p. 32, 1969.

**Hatcher, Robert D., Jr.** *See* Acker, Louis L. 01534

**Hatfield, Edward B.** *See* Anderson, Franz E. 01537

01065 **Hathaway, Donald J.** Mine geology of the New Market Zinc Company mine at New Market, *in* Papers on the stratigraphy and mine geology of the Kingsport and Mascot formations (Lower Ordovician) of East Tennessee: Tennessee Div. Geology Rept. Inv. 23, p. 53-63, illus., 1969.

The New Market mine, in Jefferson County, contains zinc in the Kingsport and part of the Mascot formations. Sphalerite occurs in breccia bodies 50 to 300 feet wide, more than 100 feet high, and as much as 1,000 feet long. The breccia bodies are further distorted by post-ore faulting. Sphalerite occurs filling the space between the breccia blocks and as coatings on the breccia blocks; it also replaces the country rock near the dolomite-limestone contact at the edges of the collapse-breccia bodies. Sphalerite is the only ore mineral in the mine, but the suggested paragenetic sequence of the gangue is first dolomite followed by sphalerite, and finally barite and hydrocarbons.-HRC

01473 **Hathaway, John C.** Regional clay mineral facies in the east coast estuaries of the United States [abs:]: Geol. Soc. America Abs. with Programs 1969, pt. 4, Southeastern Sec., p. 32-33, 1969.

01474 **Haven, Dexter S.; Morales-Alamo, Reinaldo.** Biodeposition as a factor in estuarine sedimentary processes [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 4, Southeastern Sec., p. 33, 1969.

01475 **Haven, Dexter S.; Morales-Alamo, Reinaldo.** Particle removal by filter-feeding estuarine molluscs [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 4, Southeastern Sec., p. 33-34, 1969.

01376 **Hawkes, I.; Fellers, G. E.** Theory of the determination of the greatest principal stress in a biaxial stress field using photoelastic hollow cylinder inclusions: Internat. Jour. Rock Mechanics and Mining Sci., v. 6, no. 2, p. 143-158, illus., tables, 1969.

The theoretical distribution of stress in a photoelastic biaxial gage is compared with results of an experiment on photoelastic inclusions. The sensitivity factor of such inclusions, when applied as a means of stress determination in a biaxial stress field, varies within known limits, with the major/minor principal stress ratio. It is shown that on a 1-in. long meter a standard sensitivity factor of 500 psi/fringe is acceptable when comparative accuracy is desired on materials from 10,000 to 20,000 psi compressive strength. For plastic and rocks with a uniaxial compressive strength less than 10,000 psi, a lower sensitivity factor of 450 psi/fringe would be appropriate, and for high strength concretes and rocks with strength of 20,000 psi or more, a factor of 550 psi/fringe should be applied.-*from* Authors' abstract

07312 **Hawkins, J. E.** Seismic signatures, *in* Use of space systems for planetary geology and geophysics-AAS Symposium, Boston, Mass., 1967, Proc.: Tarzana, Calif., Am. Astronaut Soc. (AAS Sci. and Technology Ser., V. 17), p. 225-236, illus., 1968.

Seismic waves are classified according to natural and artificial or man-made source. The different types have certain characteristics that when displayed may be termed 'signatures.' The information that can be obtained from seismic signatures probably exceeds that obtainable from any other application of a field to a medium. Some examples are knowledge of the Earth's crust and mantle, elastic properties of rocks, location of structures favorable to oil accumulation, depth of sea bottom, detection and location of nuclear explosions and submarines. Utilization of present seismic instruments and techniques will yield valuable data on other planets.-*from* Author's abstract

07284 **Hawkins, William K.; Gearhart, Marvin.** Use of logging in uranium prospecting, *in* SPWLA Logging Symposium, 9th Ann., New Orleans, La., 1968, Trans.: Houston, Tex., Soc. Prof. Well Log Analysts, p. T1-T13, illus., table, 1968.

Determination of the uranium ore grade by use of well logging tools in small diameter drill holes through the ore deposits is an important phase of the economic evaluation of the prospect. Wide range gamma ray counting systems for this purpose are described, with particular emphasis on the downhole wide range gamma gross count probe. Gamma detector types, calibration of the system, and interpretation methods are reviewed. The "hardware" characteristics are detailed to provide an understanding of equipment capabilities and limitations. Experimental data obtained on down hole gamma spectral logging indicates the complexity of the information received will require additional processing to be of value in mineral identification. Solid state detectors may aid in providing solutions due to their improved resolution. Other types of logs being used and their purpose are also included.-*from* Authors' abstract

01476 **Hayes, Miles O.** Forms of sand accumulation in estuaries [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 4, Southeastern Sec., p. 34, 1969.

01284 **Hazel, Joseph E.; Waller, Thomas R.** Stratigraphic data and length of the synodic month [discussion of paper by G. Paunella, C. MacClintock, and M. N. Thompson, 1968]: Science, v. 164, no. 3876, p. 201-202, 1969.

Pannella, MacClintock, and Thompson (ibid., v. 162, no. 3855, p. 792-796, 1968) presented evidence of variations in length of the synodic month, based on studies of growth bandings in living and fossil organisms and suggested that the slowing down of the Earth's rotation has not taken place at a uniform rate. Attention is called here to (1) errors in age assignments of specimens due to incorrect stratigraphic data; (2) discrepancies in radiometric dates due to differences between published time scales; and (3) weaknesses in the primary growth banding data due to biological and statistical considerations. Replotting the increments per month at a corrected rate changes the curve for the Tertiary somewhat; there is no significant change in the length of the synodic month from Maestrichtian to late Paleocene, but there is a rapid decrease from late Pleistocene to the present.-DBV

01477 **Head, James W., 3d.** Definition and interpretation of aspects of ancient intertidal carbonate sedimentary environments [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 4, Southeastern Sec., p. 34-35, 1969.

**Hearn, Carter.** *See* Zietz, Isidore. 01333

01330 **Heise, Horst.** Bright glitter of Arctic black gold: Oilweek, v. 20, no. 1, p. 73-75, 105-107, illus., 1969.

In the Arctic Lowlands a thin layer of lower Paleozoic rocks covers the Precambrian, but thickens and changes facies toward the Franklinian geosyncline, which follows an arcuate course from Prince Patrick to Ellesmere Island, and then 900 mi northeast. Paleozoic folding characterizes the province; it was a region of profound subsidence in Cambrian-Devonian time. A mixture of source and reservoir rocks may be 35,000-feet thick. Caledonian and early Variscan tectonics are recognized. The Sverdrup basin has a sedimentary section of 60,000 feet and stretches for 1,000 mi inside the Franklinian geosyncline. Clastic deposits include some Paleozoic, but are mostly Mesozoic and Tertiary. It is considered the most promising place for big oil reserves. The Arctic Coastal Plain contains thick wedges of sedimentary rocks under the Mackenzie Delta, and fringes the western margins in the Archipelago.-ESL

**Hem, J. D.** *See* Roberson, C. E. 01318

07232 **Henderson, E. P.** Patterned ground in southeastern Newfoundland: Canadian Jour. Earth Sci., v. 5, no. 6, p. 1443-1453, illus., table, 1968.

Patterned ground occurs on the Avalon Peninsula, in the main restricted to the higher exposed areas of the southern half. It resembles that previously thought to be confined to low elevations and high latitudes. There is no permafrost on Avalon. The patterns were formed by low summer temperatures, general thinness or absence of snow cover in the winter, and a severe maritime climate. These, combined with sparse vegetation and hard till underlying the frost-churned soils, produce the patterns. Fossil frost structures therefore should not everywhere be assumed to indicate much more than severe climate, perhaps with permafrost, in the past. They may merely indicate an earlier, intensely maritime-climate with a moderate winter but a low mean, annual temperature.-*from* Author's abstract

**Hendricks, E. L.** *See* Mullineaux, D. R. 01170

**Hendricks, E. L.** *See* Sigafoos, Robert S. 01184

**Henry, Vernon J.** *See* Kilbourne, Richard T. 01490

**Henry, Vernon J., Jr.** *See* Levy, John S. 01414

01478 **Hermes, O. Don.** Comparative petrochemistry of coexistent mafic silicates from the Mecklenburg gabbro and metagabbro [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 4, Southeastern Sec., p. 35-36, 1969.

**Heron, S. Duncan, Jr.** *See* Judd, James B. 01489

01359 **Herrmann, Robert B.** The structure of the Cincinnati Arch as determined by short period Rayleigh waves: Seismol. Soc. America Bull., v. 59, no. 1, p. 399-407, illus., tables, 1969.

The propagation of Rayleigh waves with periods of 0.4 to 2.0 seconds across the Cincinnati Arch is investigated. The region of investigation includes southern Indiana and Ohio and northern Kentucky. The experimental data for all paths are fitted by a three-layer model of varying layer thickness but of fixed velocity in each layer. The resulting inferred structural picture is in good agreement with the known basement trends of the region. The velocities of the best fitting theoretical model agree well with velocity-depth data from a well in southern Indiana.-Author's abstract

01479 **Hess, Frederick R.; Anderson, Franz E.** Two unique estuarine sampling problems and their solutions [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 4, Southeastern Sec., p. 36, 1969.

01183 **Hewett, D. F.; Stone, Jerome; Stieff, Lorin R.** The ages of three uranium minerals, Mojave Desert, California, *in* Geological Survey research 1969, Chap. B: U.S. Geol. Survey Prof. Paper 650-B, p. B84-B88, tables, 1969.

The Mojave Desert region of southeastern California contains many coarse-grained quartz monzonite intrusions whose ages are important to the understanding of the region's geologic history. Betafite from one pegmatite and polycrase from another indicate ages that may range from 72 to 80 m.y., or the Late Cretaceous. Uraninite has been found in a crushed zone in quartzite about 21 miles southeast of Twentynine Palms.-Authors' abstract

07326 **Hewitt, D. F.** Industrial mineral resources of the Hamilton area: Ontario Dept. Mines Indus. Mineral Rept. 27, 26 p., illus., tables, geol. map, 1968.

The southeastern part of the map-sheet is occupied by Lake Ontario, and the Niagara Escarpment extends up the west side. Dolomites capping the escarpment are quarried for crushed stone. The Whirlpool Sandstone at the base of the Silurian, was quarried for ganister and silica grit. Below this the red Queenston Shale is quarried for brick, tile, and sewer pipe. The Meaford-Dundas Shale outcrops beneath the Queenston. Pleistocene deposits include kame and spillway gravels in the northwest, and extensive outwash sand farther south on the escarpment. The central part is covered with till. The Lake Iroquois shoreline runs diagonally northeast across the map area; it is cut mainly in Queenston Shale. Lacustrine sand occurs between the ancient shoreline and the Lake Ontario shore. [A map showing drift thickness series accompanies the Pleistocene geologic map.]-*from* Author's abstract

01480 **Heylmun, Edgar B.** Geologic significance of the passage of the Earth through the galactic plane [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 4, Southeastern Sec., p. 36, 1969.

01247 **Hietanen, Anna.** Distribution of Fe and Mg between garnet, staurolite, and biotite in aluminum-rich schist in various metamorphic zones north of the Idaho batholith: Am. Jour. Sci., v. 267, no. 3, p. 422-456, illus., tables, 1969.

Garnet, staurolite, biotite, and muscovite from aluminum-rich schists north of the Idaho batholith were analyzed chemically. Chemical analyses of the host rocks show that the bulk composition of the schist is fairly uniform. All rock analyses plot near the Al corner on Al-Fe-Mg diagrams. Pressures during the second episode of metamorphism-the episode responsible for the present mineralogy-were fairly uniform, but temperature increased toward the batholith. The distribution of Mg and Fe between garnet and biotite changed with the temperature, the distribution coefficient $K_D$ (Mg/Fe) (gar/bi) increasing from 0.106 in the garnet zone to 0.225 in the sillimanite-muscovite zone.-*from* Author's abstract

07281 **Hilchie, D. W.; Mills, W. R.; Dennis, C. L.; Givens, W. W.** Some aspects of pulsed neutron logging, *in* SPWLA Logging Symposium, 9th Ann., New Orleans, La., 1968, Trans.: Houston, Tex., Soc. Prof. Well Log Analysts, p. Q1-Q26, illus., table, 1968.

In recent years pulsed neutron logging has become an important commercial logging service. This paper is a critical review of the problems which confront thermal pulsed neutron (lifetime) logging today. To achieve a good interpretation the log analysts must be aware of the "physics" of the tool operation as well as the normal sources of error. The latter are a function of the location of the time windows, depth of investigation of the measurement, statistical uncertainties and the source-to-detector spacing. A quantitative interpretation of the existing tools requires more than a simple reading of the well log curves and formulas. The commercial pulsed neutron logs are doing a good job and afford us information previously not obtainable. Pulsed neutron logging is in its infancy and we expect that future improvements and refinements of this technique will materially improve our ability to locate hydrocarbons.-Authors' abstract

01387 **Hill, David P.** Crustal structure of the Island of Hawaii from seismic-refraction measurements: Seismol. Soc. America Bull., v. 59, no. 1, p. 101-130, illus., tables, 1969.

Results of refraction profiling along the coasts of the Island of Hawaii suggest that the crust under Hawaii has two principal layers: a basal layer 4 to 8 km thick with P-wave velocities of 7.0 and 7.2 kmps, and an upper layer 4 to 8 km thick in which P-wave velocities increase with depth from 1.8 to 3.3 kmps at the surface to 5.1 to 6.0 kmps at depth. The basal layer is probably the original oceanic crust plus the intrusive system associated with central vents and rift zones, and the upper layer is the accumulated pile of lava flows that form the bulk of the island. Early P-wave arrivals associated with the summits and major rift zones of the volcanoes indicate that material with velocities as high as 7.0 kmps approaches within 2 or 3 km of the surface under these structures and merges at depth with the 7.1- to 7.2-kmps layer forming the base of the crust.-*from* Author's abstract

01067 **Hill, William T.** Mine geology of the New Jersey Zinc Company's Flat Gap mine at Treadway in the Copper Ridge district, *in* Papers on the stratigraphy and mine geology of the Kingsport and Mascot formations (Lower Ordovician) of East Tennessee: Tennessee Div. Geology Rept. Inv. 23, p. 76-90, illus., 1969.

Zinc ore is generally confined to the upper 150 feet of the Kingsport Formation and the lower 60 feet of the overlying Mascot Dolomite. The major ore-bearing bodies are collapse breccias formed by the solution of the underlying Kingsport and the subsequent collapse of the Mascot. Two distinctly different types of sphaleritic mineralization occur. The earlier type is confined to a single, eastward plunging, long narrow ore shoot which is crustiform, laminated, typically fine-grained, and colored; galena is a common associate. The later mineralization is light yellow crystalline sphalerite similar in appearance and occurrence to the other ore bodies in the Jefferson district in that it fills the breccia spaces and coats the breccia blocks.-HRC

**Hillier, D. E.** *See* Winslow, A. G. 07142

**Hirashima, G. T.** *See* Takasaki, K. J. 01316

**Hjelmstad, K. E.** *See* Bur, T. R. 01377

01059 **Hoare, R. D.; Steller, D. L.** Inarticulate brachiopods of the Silica Formation (Devonian), Ohio and Michigan Michigan Univ. Mus. Paleontology Contr., v. 22, no. 20, p. 263-272, illus., 1969.

Fifteen species, one new, of ten genera of inarticulate brachiopods are described from the Middle Devonian Silica Formation in northwestern Ohio and southeastern Michigan. Specimens were most abundant in unit 9 in the Medusa Quarry near Silica, Ohio, about 12 feet above the base of the formation. *Philhedra crenistriata*, *P. sheldoni*, *P. stewarti*, *Petrocrania hamiltoniae*, *Acanthocrania chilmanae*, n.sp., and *Lingulodiscina marginalis* are commonly found attached to articulate brachiopods, bryozoan colonies, or rugose corals. *Dignonia alveata*, *Trigonoglossa truncata*, *?Craniops hamiltoniae*, *Orbiculoidea doria*, *Roemerella grandis*, and four species of *Lingula* are normally found as isolated valves along bedding planes in the shales.-*from* Authors' abstract

01481 **Hobday, David K.** The relationship between "Mississippian" and "Pennsylvanian" facies in the Appalachian Plateau of northern Alabama [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 4, Southeastern Sec., p. 37, 1969.

**Hodson, Warren G.** *See* McGreevy, Laurence J. 01312

01244 **Hoffman, Victor Joseph.** The mineralogy of the Mapimí mining district, Durango, of the lower Beaverhead River Basin, Madison and Beaverhead Counties, Montana-Pt. 2, Paleontology and depositional environments [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 3, Cordilleran Sec., p. 26, 1969.

07192 **Hoffman, Victor Joseph.** The mineralogy of the Mapimí mining district, Durango, Mexico [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 29, no. 4, p. 1406B, 1968.

01326 **Hollister, Lincoln S.** Metastable paragenetic sequence of andalusite, kyanite, and sillimanite, Kwoiek area, British Columbia: Am. Jour. Sci., v. 267, no. 3, p. 352-370, illus., 1969.

A model involving initial metastable crystallization of andalusite in a contact metamorphic terrane near the Coast Range batholith is proposed to explain a constant lithostatic pressure, increasing temperature observed sequence. Texturally, fibrolite occurs as a phase distinct from sillimanite and at a lower temperature than the first appearance of sillimanite. Evidence for the metastable origin of the andalusite comes from: polymorphs distribution, textural relations in coexisting polymorphs, and a comparison of the transition sequence andalusite to kyanite to sillimanite with a second one, presumed to be contemporaneous, involving only andalusite and fibrolite. Comparison of the observed field data with experimentally determined stability fields of staurolite and aluminum silicates suggest that the prevailing pressures of the Coast Range batholith were between 5.5 and 7.1 kb.-*from* Author's abstract

**Hopps, H. C.** *See* Cannon, H. L. 07305

01179 **Hosterman, John W.** White clay deposits near Mount Holly Springs, Cumberland County, Pennsylvania, *in* Geological Survey research 1969, Chap. B: U.S. Geol. Survey Prof. Paper 650-B, p. B66-B72, illus., table, 1969.

In the vicinity of Mount Holly Springs are at least five deposits of white clay, all in rocks of Early Cambrian age. The only operating deposit at present is the clay pit leased by the Philadelphia Clay Co. Here, the deposit is approximately 200 feet by 1,600 feet and at least 150 feet deep. The white clay is composed of 70 percent clay, 24 percent silt, and 6 percent sand. The clay fraction is composed of kaolinite and illite in a ratio of 9:1. The white clay averages 71 percent $SiO_2$ and 19 percent $Al_2O_3$ on the pit floor but changes to 62 percent $SiO_2$ and 25 percent $Al_2O_3$ at a depth of 150 feet. Traces of alunite have been found in the deposit, indicating that the clay was probably formed in part by hydrothermal alteration.-Author's abstract

**Hough, Van Ness D.** *See* Nickelsen, Richard P. 01297

**Howard, James D.** *See* Mikesh, D. L. 01450

01482 **Howard, James D.** Primary physical and biogenic structures of estuarine sediments-Doboy and Sapelo Sounds, Georgia [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 4, Southeastern Sec., p. 37-38, 1969.

**Howard, James F.** *See* DuBar, Jules R. 01410

01483 **Hoyt, John H.** Erosional and depositional estuarine "terraces", southeastern United States [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 4, Southeastern Sec., p. 38, 1969.

**Hoyt, John H.** *See* Hails, John R. 07319

01260 **Huckenholz, H. G.** Synthesis and stability of Ti-andradite: Am. Jour. Sci., v. 267-A (Schairer Volume), p. 209-232, illus., tables, 1969.

Ti-rich andradites from magmatic and metamorphic rocks plot in the enstatite-wollastonite-hematite-perovskite system on or below the plane wollastonite-hematite-perovskite and close to the join andradite-Ti-garnet. The phase relations in the plane wollastonite-hematite-perovskite bear directly on the formation of andradite and its Ti-bearing varieties. A series of compositions were studied in the plane and along the join andradite-Ti-garnet. Stable phases are garnet solid solution, pseudowollastonite, hematite, and perovskite solid solution. The various garnet appear at different places depending upon the temperature.-HRC

**Hudson, J. D.** *See* Busch, F. E. 01303

01369 **Hunt, Bruce W.** Flow rates in two-dimensional, unsteady, confined groundwater flow: Am. Soc. Civil Engineers Proc., v. 95, paper 6451, Jour. Hydraulics Div., no. HY 2, p. 603-608, 1969.

It has been shown how unsteady flow rates in two-dimensional, confined aquifers can be calculated from steady-state solutions. The final results reveal that unsteady flow rates will eventually approach flow rates which are obtained by simply replacing constant heads in the steady-state solutions with heads that vary with time. It has also been shown that the relative difference between "steady" and unsteady flow rates will be small when the permeability of the aquifer is small and when heads along the aquifer boundary are not changing rapidly with time.-Author's conclusions

01484 **Hunt, Graham.** Precambrian geology of Iskwasum Lake, Manitoba, Canada [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 4, Southeastern Sec., p. 38-39, 1969.

**Hunter, J. A.** *See* Mercu, R. F. 01389

**Hunter, Ralph E.** *See* Clifton, H. Edward. 01308

07249 **Hussey, Arthur M., 2d.** Stratigraphy and structure of southwestern Maine, Chap. 22 *in* Studies of Appalachian geology, northern and marine (Zen, E-an, and others, editors): New York and London, Interscience Publishers, p. 291-301, illus., tables, 1968.

Southwestern Maine is underlain by a diverse eugeosynclinal sequence of metasedimentary and metavolcanic rocks of Ordovician to Early Devonian(?) age, which were deformed during the Acadian orogeny in Middle and Late Devonian time. These rocks range from the lower greenschist to the upper almandine-amphibolite facies and were metamorphosed during the Acadian orogeny and possibly again during the Permian. Later in the Acadian orogeny the stratified rocks were invaded by calc-alkaline granitic and dioritic magmas of the New Hampshire Plutonic Series. Three suites of igneous rocks were emplaced after the Acadian orogeny: (1) alkalic granites and syenites of the White Mountain Plutonic-Volcanic Series, (2) basic dikes that are possibly Triassic, and (3) gabbroic complexes that may be Cretaceous.-JWC

**Hutchinson, G. Evelyn.** *See* Cowgill, Ursula M. 01251

**Jaffe, Howard W.** *See* Robinson, Peter. 01246

07183 **Javandel, Iraj.** Analysis of transient fluid flow in multi-layered systems [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 29, no. 4, p. 1347B, 1968.

**Jenkins, Ralph E.** *See* Granberry, Raymond J. 07278

01485 **Jenne, E. A.; Chao, T. T.** Geochemical controls on water quality-Hydrous oxides of Mn, Fe, Al, and Si [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 4, Southeastern Sec., p. 39, 1969.

01289 **Jepsen, Glenn L.; Woodburne, Michael O.** Paleocene Hyracothere from Polecat Bench Formation, Wyoming: Science, v. 164, no. 3879, p. 543-547, illus., tables, 1969.

A lower jaw of an eohippus (*Hyracotherium* cf. *H. angustidens*) from late Paleocene strata in Wyoming has extended the geological record of fossil horses into pre-Eocene time and suggests that the order Perissodactyla had an origin earlier than that heretofore conjectured. This specimen, together with equid teeth also possibly of late Paleocene age from Baja California, indicates that early perissodactyls were widespread on the North American continent before the Eocene epoch. Late Paleocene and early Eocene deposits of northwestern Wyoming have yielded many vertebrate rarities and "first or earliest occurrences" which require reappraisals of inter- and intra-continental dispersal patterns of the vertebrate groups involved.-Authors' abstract

01310 **Johnson, H. E.; Axford, W. I.** Production and loss of He-3 in the Earth's atmosphere: Jour. Geophys. Research, v. 74, no. 9, p. 2433-2438, illus., table, 1969.

This note examines in detail the problem of finding a production process adequate to account for the observed concentration of He-3 in the atmosphere and the calculated losses due to "evaporation" and "nonthermal" processes such as the polar wind. It is concluded that the main source of atmospheric He-3 is the precipitation of energetic magnetospheric particles (especially in the aurora), and that these in turn should originate in the solar wind.-DBV

**Johnson, Henry S.** *See* Judd, James B. 01489

07176 **Johnson, J. Harlan.** Lower Cretaceous algae from the Blake Escarpment, Atlantic Ocean, and from Israel-Pt. 1, Lower Cretaceous algae from the Blake Escarpment, Atlantic Ocean: Colorado School Mines Prof. Contr., no. 5, p. 1-27, 45-46, illus., tables, 1968.

Fourteen species belonging to nine genera of algae are described from limestone samples dredged from the Blake Escarpment at depths from 2300 to 3000 meters. One species, a solenoporacean, belongs among the red algae, all the others are green. Two species of green algae are described as new: *Pianella atlantica*, a codiacean, and *Salpingoporella oceania*, a dasyclad.-*from* Author's abstract

01306 **Johnson, Paul Willard.** Common gems of San Diego County, California: Gems and Gemology, v. 12, no. 12, p. 358-371, illus., 1968-69.

San Diego County is rich in gem minerals; more than 140 different minerals have been reported, mostly occurring in vugs in pegmatite dikes. Mines are developed in a central mountain belt trending northwest-southeast, which is divided into eight main pegmatite districts, the two principal ones being Pala and Mesa Grande; lepidolite is a valuable mineral indicator. The history of gem discoveries and production is sketched. Pegmatite dikes and the following gem stones are described: beryl, spessartite, topaz, and tourmaline.-ESL

**Johnson, Ronald D.** *See* Nelson, Samuel J. 07320

01486 **Jones, Michael L.; Eddy, Greg E.** A computer program for statistical analysis of two-dimensional orientation data-Some geologic applications [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 4, Southeastern Sec., p. 39, 1969.

01487 **Jordan, R. R.; Oostdam, B. L.** Aspects of sediment transport in the Delaware Estuary [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 4, Southeastern Sec., p. 40, 1969.

01488 **Josey, William L.; Kesler, Stephen E.** Metamorphic rocks of the Santa Barbara-Huehuetenango area, western Guatemala [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 4, Southeastern Sec., p. 40-41, 1969.

01489 **Judd, James B.; Heron, S. Duncan, Jr.; Johnson, Henry S.** Clastic dikes in the North and South Carolina Coastal Plain [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 4, Southeastern Sec., p. 41, 1969.

**Kandle, J. R.** *See* McCulloh, T. H. 07279

07258 **Kane, M. F.; Bromery, R. W.** Gravity anomalies in Maine. Chap. 31 *in* Studies of Appalachian geology, northern and marine (Zen, E-an, and others, editors): New York and London, Interscience Publishers, p. 415-423, illus., 1968.

The Bouguer gravity anomaly map of Maine shows four northeast-trending zones, which are separated by gravity gradients, and a fifth zone in the southwest corner of the State. The clearest correlation between gravity and geologic features is that of large negative anomalies associated with granitic masses. There is an equally good correlation between positive anomalies and mafic intrusions; the latter are fewer in number, however. The cause of the regional gravity pattern is believed to be related to regional geologic features rather than to deep crustal sources.-JWC

07239 **Kanehira, K.; Bachinski, D.** Mineralogy and textural relationships of ores from the Whalesback Mine, northeastern Newfoundland: Canadian Jour. Earth Sci., v. 5, no. 6, p. 1387-1395, illus., 1968.

This Ordovician deposit consists of veins, pods, and disseminated sulfides localized within a highly chloritized shear zone cutting basaltic pillow lavas. Porphyritic dikes cut the shear zone, sulfide deposit, and the surrounding lavas, and all have been regionally metamorphosed. Ore minerals, in decreasing abundance are: pyrite, chalcopyrite, pyrrhotite, sphalerite, and others. Quartz and chlorite are the predominant gangue. Banding and streaking of sulfides in the massive ore, crushed pyrite, and the local occurrence of pressure-shadow phenomena in the ore are indicative of shearing stress post-dating original sulfide ore formation. Present sulfide assemblages are compatible with relatively low temperatures and are the result of re-equilibration and internal reaction among the sulfides with decreasing temperatures.-*from* Authors' abstract

**Kartha, T. D. Krishna.** *See* Williams, John A. 01397

**Kasabach, Haif F.** *See* Vecchioli, John. 01197

**Kator, I. H.** *See* Brogden, W. B. 01407

07290 **Katz, Donald LaVerne; Coats, Keith Hal.** Underground storage of fluids: Ann Arbor, Mich., Ulrich's Books, 575 p., illus., tables, 1968.

The fifteen chapters cover: use of the earth for storage; geological information; properties of rock; properties of fluids; drilling, completing and equipping of wells; flow in wells and adjacent reservoir rock; hydraulics of aquifers; conversion of gas fields to storage; development of an aquifer storage reservoir; operating information on selected storage fields; detection and control of underground gas movement; use of computers in predicting gas storage operations; storage in salt cavities; frozen earth storage-LPG, mined caverns, nuclear cavities; and liquefied natural gas.-ESL

**Kennedy, G. C.** *See* Yamamoto, H. 01265

**Kesler, Stephen E.** *See* Josey, William L. 01488

01058 **Kesling, Robert V.** *Silicaster*, a new genus of Devonian starfish: Michigan Univ. Mus. Paleontology Contr., v. 22, no. 19, p. 249-261, illus., table, 1969.

*Silicaster esseri* n. gen. and sp., from the Silica Shale, northwestern Ohio, is assigned to the Calliasterellidae, order Forcipulatida. The small disk has various kinds of plates, some stellate with long prongs and others blocky, loosely associated in a central papular area; sides of disk are buttressed by large axillaries. The long arms are composed of rows of radials, inferomarginals, and adambulacrals except in the distal ends, where all plates are subquadrate and closely spaced, the radials are sharply quadristellate, the inferomarginals paddle-shaped with long adradial extensions, and the adambulacrals with robust longitudinally ridged spines on the oral surfaces. Distinctions from *Calliasterella* and *Urasterella* are discussed.-*from* Author's abstract

01060 **Kesling, Robert V.** Copulatory adaptations in ostracods-Pt. 3, Adaptations in some extinct ostracods: Michigan Univ. Mus. Paleontology Contr., v. 22, no. 21, p. 273-312, illus., 1969.

Shapes of male and female carapaces within taxonomic groups of extinct ostracods strongly suggest that certain mating positions were feasible, others highly improbable, and some seemingly impossible. Carapace dimorphism is illustrated and discussed, with interpretation of probable adaptations to mating position, for numerous Paleozoic taxa of the suborder Beyrichicopina of palaeocope ostracods, among which dimorphism is developed most strongly and diversely. The families Eurychilinidae, Piritellidae, Beyrichiidae (7 subfamilies), Tetradellidae, Oepikiumidae, Hollinidae, Primitiopsidae, and Oepikellidae are represented. Detailed study of the functions of carapace configuration may improve taxonomy and illuminate evolutionary trends.-VMJ

**Kesling, Robert V.** *See* McGregor, Don L. 01072

01074 **Kesling, Robert V.** Two new crinoids from the Middle Devonian Silica Formation: Michigan Univ. Mus. Paleontology Contr., v. 22, no. 15, p. 199-206, illus., tables, 1969.

New crinoids from the Silica Formation in northwestern Ohio are named *Gennaeocrinus dulukae* and *Poteriocrinites duluki*. The Gennaeocrinus is characterized by bowl-shaped cup, low crests and spinelike nodes on RR, $PBrBr_1$, and $IBrBr_2$, narrow arms, and interbrachials developed as high as IQBrBr; the preserved part of the calyx shows 6 arms per ray with two arms on each inner quarter-ray. The *Poteriocrinites* is characterized by subconical cup, elevated narrow RR facets, broad and slightly rugose radiating ridges on IBB, BB, RR, Ra, and $X_1$ (with double crests on B-B ridges), median shallow grooves on IBB, and strongly pentastellate heteromorphic column.-Author's abstract

**Kesling, Robert V.** *See* McGregor, Don L. 01076

01172 **Ketner, Keith B.** Ordovician bedded chert, argillite, and shale of the Cordilleran eugeosyncline in Nevada and Idaho, *in* Geological Survey research 1969, Chap. B: U.S. Geol. Survey Prof. Paper 650-B, p. B23-B34, illus., tables, 1969.

A large proportion of Ordovician rocks in the Cordilleran eugeosyncline forms a compositionally continuous series whose end members are bedded chert and siliceous shale. Principal minerals are quartz and illite. Illite flakes are assumed to be detrital or to be derived from detrital clay. Quartz grains are of three kinds: scattered detrital grains of silt size, scattered radiolarian tests and about 0.15 mm in diameter, and matrix grains of problematic origin about 0.005 mm in diameter. The hypothesis is offered that much of the fine-grained matrix quartz in rocks of this series was formed by inorganic precipitation of quartz from marine bottom waters of nearly normal silica content.-Author's abstract

**Khoury, S. G.** *See* Abdel-Khalek, M. Lotfi. 01533

01490 **Kilbourne, Richard T.; Henry, Vernon J.** Holocene foraminiferal zonation on the continental shelf of the southeastern United States [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 4, Southeastern Sec., p. 41-42, 1969.

01491 **Kilham, Susan S.** Skeletal structures in deep-sea molluscs [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 4, Southeastern Sec., p. 42, 1969.

**Killeen, P. G.** *See* Sass, J. H. 07230

01357 **King, Chi-Yu; Knopoff, Leon.** A magnitude-energy relation for large earthquakes: Seismol. Soc. America Bull., v. 59, no. 1, p. 269-273, illus., 1969.

A relation between the magnitude of a shallow earthquake and the rupture parameters is derived by using a result of dislocation theory and assumptions as suggested from model studies: the average of the pre- and post-shock stresses on a fault and the seismic efficiency are approximately constant. Comparing this relation with observations of the rupture parameters for a number of large shallow earthquakes, the magnitude-energy relation $\log E_s = \alpha + 1.7\ M$ is obtained. The value of $\alpha$ is estimated to be approximately 10.-Authors' abstract

**Kirby, S. H.** *See* Segerstrom, Kenneth. 01171

**Kleppa, O. J.** *See* Anderson, P. A. M. 01233

**Knopoff, Leon.** *See* King, Chi-Yu. 01357

**Knowles, C. R.** *See* Chinner, G. A. 01275

01371 **Ko, Hon-Yim; Scott, Ronald F.** Deformation of sand in hydrostatic compression-Closure [to discussion of paper 5245, 1967]: Am. Soc. Civil Engineers Proc., v. 95, paper 6429, Jour. Soil Mechanics and Found. Div., no. SM 2, p. 627, 1969.

The possibility of anisotropy of the sample due to preparation [paper 5245, ibid., v. 93, no. SM 3, p. 137-156, 1967] was investigated by the writers and it was concluded that the samples were quite isotropic. Regarding the question of packings, the authors reasoned that only the use of the loosest and densest packings, 6 and 12 contacts per sphere, would cover the whole range of porosities.-ESL

01199 **Koch, Neil C.** Effects of reservoir filling on a buried aquifer of glacial origin in Campbell County, South Dakota, *in* Geological Survey research 1969, Chap. B: U.S. Geol. Survey Prof. Paper 650-B, p. B169-B173, illus., 1969.

The filling of the Oahe Reservoir, which raised the reservoir surface west of Pollock, S. Dak., about 47 feet by December 1967, has produced a rise in the piezometric surface in a large buried artesian aquifer of glacial origin. The rise resulted in water-level rises of 34, 22, 20, and 17 feet in wells about 4, 11 1/2, 16 1/2, and 18 miles, respectively, from the reservoir. The piezometric surface 4 miles from the reservoir was about 13 feet above reservoir level as of December 1967. The aquifer is practically undeveloped. If development of the aquifer lowers the level of the piezometric surface below that of the reservoir surface, the hydraulic gradient would reverse and induce recharge from the Oahe Reservoir. This would provide a nearly unlimited water supply and would eventually improve the quality of water in the aquifer.-Author's abstract

07172 **Koch, Neil C.** Ground-water resources of Greenville County, South Carolina: South Carolina Devel. Board Bull. 38, 47 p., illus., tables, geol. map, 1968.

Ground water in Greenville County occurs in both crystalline rock (yields up to 200 gpm) and in the saprolite or overlying sediments (yields up to 5 gpm). Geologic conditions to look for in selecting a well site are coarse textured rock, joints and fractures, quartz veins, and thick saprolite and overlying sediments. Ground water is generally slightly acidic except where it comes in contact with diabase dikes, and is usually soft.-*from* Author's abstract

01413 **Kopp, Otto C.; Sutton, Thomas C.** Effects of regional metamorphism on the clay minerals of the Valley and Ridge and Blue Ridge Provinces of southeastern Tennessee [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 4, Southeastern Sec., p. 42-43, 1969.

01464 **Kover, Allan N.; Luttrell, Gwendolyn W.** Sidelooking radar imagery of southeastern United States [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 4, Southeastern Sec., p. 43, 1969.

01188 **Koyanagi, Robert Y.** Hawaiian seismic events during 1966, *in* Geological Survey research 1969, Chap. B: U.S. Geol. Survey Prof.Paper 650-B, p. B113-B116, illus., 1969.

During 1966, 388 earthquakes having a magnitude of 2.0 to 4.5 occurred in the Hawaiian Islands. The foci of four-fifths of these were along structural features beneath the active Kilauea and Mauna Loa volcanoes. Nearly 100 earthquakes were felt by residents of the Island of Hawaii.-Author's abstract

01231 **Kranck, E. H.** Peter Kalm's geological observations in New France, 1749: Canadian Jour. Earth Sci., v. 6, no. 2, p. 347-352, illus., 1969.

In 1749 Peter Kalm, a Finnish professor and naturalist, journeyed up the Hudson River, across Lake Champlain, to Montreal and thence down the St. Lawrence River. His notebooks of this journey contain many geological observations, the accuracy of which is remarkable, and merit him a place in the early history of geology of Canada.-Author's abstract

01189 **Krivoy, Harold L.; Mears, Connally E.** Seismic events originating at the Atomic Energy Commission's Nevada Test Site, *in* Geological Survey research 1969, Chap. B: U.S. Geol. Survey Prof. Paper 650-B, p. B117-B121, illus., tables, 1969.

Underground nuclear explosions at the Nevada Test Site (NTS) have been detected at a Flagstaff, Ariz., geophysical observatory since November 1966. Data on these man-made seismic events (shotpoint coordinates, shot times, and phase arrival times) were used to calculate a thickness of about 36 km for the crust between Flagstaff and the NTS. From the data of other observatories, as compiled and published by the U.S. Coast and Geodetic Survey, relationships are inferred which show a pattern of aftershocks following certain of the tests at the NTS.-Authors' abstract

01259 **Kullerud, G.** The lead-sulfur system: Am. Jour. Sci., v. 267-A (Schairer Volume), p. 233-256, illus., tables, 1969.

Phase relations of the Pb-S system were studied between 100 and 1200°C. In the Pb-PbS portion, a field of immiscible liquids exists above 1011°C and between 4.8 and 6.95 wt percent S. In the PbS-S portion, liquid immiscibility occurs above 800°C over a wide range of compositions (27.2 to more than 93.2 wt percent). Monotectic conditions exist at 1041°C and 6.95 wt percent S and at 800°C and 27.2 wt percent S. Eutectic conditions exist on the Pb-PbS join at about 326.5°C and a composition very near pure Pb. A second eutectic is situated near S composition at a temperature slightly lower than the melting point of pure S. The occurrence of primary galena is accounted for by considering the stability curves of this mineral in a P-T diagram. A mechanism for galena transport in gas or vapor phase exists which may play an important role in ore formation.-*from* Author's abstract

01263 **Kunkler, J. L.** The sources of carbon dioxide in the zone of aeration of the Bandelier Tuff, near Los Alamos, New Mexico, *in* Geological Survey research 1969, Chap. B: U.S. Geol. Survey Prof. Paper 650-B, p. B185-B188, illus., tables, 1969.

Circulation of gas in the zone of aeration of the Bandelier Tuff in the vicinity of Los Alamos, N. Mex., has been under study for several years. Clues to the circulation pattern may be obtained from the carbon dioxide composition and concentration in the zone of aeration. Techniques for collection of samples of carbon dioxide for various analyses have been developed. Analyses of the data show that the carbon dioxide is of mixed origin, part is atmospheric and part is biogenic. Radiocarbon ages for the carbon dioxide could not be determined because of contamination in the zone of aeration by artifically produced radiocarbon.-Author's abstract

01313 **Kurtén, Björn.** Continental drift and evolution: Sci. American, v. 220, no. 3, p. 54-64, illus., 1969.

Reptiles dominated the vertebrates for 200 m.y. during which time they diversified into 20 orders. During the following 65 m.y. in which mammals dominated the vertebrates, 30 mammalian orders developed. The author suggests in this popular article that the difference in rate of diversification is related to global tectonics. Reptiles evolved on the supercontinents of Laurasia and Gondwanaland. Mammals diversified on several continents following the breakup of the supercontinents.-DWR

**Kushiro, I.** *See* Yoder, H. S., Jr. 01269

01258 **Kushiro, Ikuo.** The system forsterite-diopside-silica with and without water at high pressures: Am. Jour. Sci., v. 267-A (Schairer Volume), p. 269-294, illus., tables, 1969.

The system is studied at 20 kb. Under anhydrous conditions, the forsterite-pyroxene liquidus boundary shifts toward forsterite with an increase of pressure from 1 atm to 20 kb; at 20 kb the join diopside-enstatite is a thermal barrier between silica-saturated and silica-undersaturated parts of the system forsterite-diopside-silica. Under hydrous conditions the forsterite-enstatite solid solution liquidus boundary does not shift toward forsterite but shifts toward silica with increasing pressure. At 20 kb forsterite is on the liquidus over a wide compositional range in the join diopside-enstatite and is not a thermal barrier. If partial melting of lherzolite, which is believed to be the upper mantle material, takes place at pressures greater than at least 10 kb under anhydrous conditions, liquids undersaturated with respect to silica are formed.-*from* Author's abstract

01202 **Lal, R. K.; Moorhouse, W. W.** Cordierite-gedrite rocks and associated gneisses of Fishtail Lake, Harcourt Township, Ontario: Canadian Jour. Earth Sci., v. 6, no. 1, p. 145-165, illus., tables, 1969.

These rocks on the north side of Fishtail Lake are in the Grenville gneiss complex of the Haliburton Highlands. Comparison with compositional data from other metamorphic environments shows that the compositions of associated cordierite, garnet, and gedrite and garnet-cordierite-biotite have lower FeO/(MgO + FeO) ratios in high-grade regional metamorphic environments than in contact metamorphic associations. The rocks of the area were metamorphosed initially to the staurolite-almandine subfacies. The intensity was increased to sillimanite-almandine-orthoclase subfacies; the staurolite became unstable, and apart from relicts, is now represented by garnet and sillimanite. Partial anatexis took place, leading to the cordierite-gedrite assemblages. Subsequent retrograde metamorphism followed and kyanite and andalusite resulted.-*from* Authors' abstract

01353 **Lambe, T. William; Whitman, Robert V.** Soil mechanics: New York and London, John Wiley and Sons (Series in soil engineering), 553 p., illus., tables, 1969.

This text is designed as an introductory course for both graduate and undergraduate students, and also has value as a reference for the practicing engineer. The five parts of the book are: (1) introduction-soil problems in civil engineering, preview of soil behavior; (2) nature of soil-descriptions of assemblage of particles and individual soil particles, normal stress and shear resistance between soil particles, soil formation; (3) dry soil-stresses within a soil mass, measurement of stress-strain properties, stress-strain behavior and relationships, shear strength of cohesionless soil, earth retaining structures and slopes, shallow foundations, dynamic loading of soil; (4) soil with water-no flow or steady flow (10 chapters); and (5) soil with water-transient flow (9 chapters). Symbols, conversion, references, and an index are appended.-MCM

**Landisman, M.** *See* Dziewonski, A. 01384

**Langenheim, R. L., Jr.** *See* Pierce, R. W. 01435

01262 **Langmuir, Donald.** The Gibbs free energies of substances in the system Fe-$O_2$-$H_2O$-$CO_2$ at 25°C, *in* Geological Survey research 1969, Chap. B: U.S. Geol. Survey Prof. Paper 650-B, p. B180-B184, illus., table, 1969.

The Gibbs free energies of aqueous ionic and molecular species and solid phases in the system Fe-$O_2$-$H_2O$-$CO_2$ have been reevaluated, taking into account recently published thermochemical data and laboratory investigations by previous workers and by the author. The study shows that a range of thermodynamic stabilities are possible for ferric oxyhydroxides when they crystallize or are precipitated in water at temperatures near 25°C. These stabilities are expressed in terms of the activity products of the oxyhdroxides written as $K = (aFe^{+3})\ (aOH^{-1})^3$; values are given.-*from* Author's abstract

01465 **Lankford, R. R.; Rehkemper, L. J.** Depositional history of the Galveston Bay complex [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 4, Southeastern Sec., p. 43-44, 1969.

**Larson, E. E.** *See* Eggler, D. H. 01254

01466 **Larson, L. T.** Cobalt and nickel-bearing manganese oxides from the Fort Payne Formation, Tennessee [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 4, Southeastern Sec., p. 44, 1969.

**Larson, Richard R.** *See* Rose, Harry J., Jr. 01191

01467 **Lawrence, David R.** Fabric of oyster communities from the Carolinas [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 4, Southeastern Sec., p. 44-45, 1969.

01174 **Lee, Donald E.; Mays, Robert E.; VanLoenen, Richard E.; Rose, Harry J., Jr.** Accessory sphene from hybrid rocks of the Mount Wheeler mine area, Nevada, *in* Geological Survey research 1969, Chap. B: U.S. Geol. Survey Prof. Paper 650-B, p. B41-B46, illus., tables, 1969.

Chemical data, unit-cell parameters, and optical properties are listed for 14 accessory sphenes from hybrid granitoid rocks exposed north of the Mount Wheeler mine, White Pine County, Nev. The environment of these sphenes is well known from a careful field and laboratory study. These sphenes contain a large assemblage of rare-earth and other minor elements, and physical properties and major- and minor-element contents do not show the same obvious response to whole-rock chemistry observed for coexisting allanites and zircons. Four sphenes contain detectable amounts of Bi, and 13 contain Mo in the range of 7-20 ppm; the sphene structure is a preferred site for Bi and Mo in these rocks. All 14 sphenes contain a much less basic assemblage of rare earths than do coexisting allanites.-*from* Authors' abstract

**Leech, A. P.** *See* Condie, Kent C. 01295

01349 **Lefond, Stanley J.** Handbook of world salt resources: New York, Plenum Press (Monographs in geoscience), 384 p., illus., tables, 1969.

This book updates material available since publication of a similar discourse by the Louisiana Geological Survey in 1908 (Bull. 7, Harris). Contents are grouped geographically as follows: North America, Central America, West Indies, South America, Europe, Africa, Asia, and Oceania. Eighty maps illustrate salt deposits; charts and tables show localities, production, and analyses. The four major salt basins in the United States (Gulf Coast, Permian, Salina, Williston) underlie 18 states and eight other states have deposits. Extensive deposits underlie a large portion of Saskatchewan, Alberta, and part of southwestern Manitoba. Mexico's resources are in the north and in the Isthmus of Tehuantepec. Although there are no known deposits in Central America, small scattered salt areas are known in the West Indies.-MCM

07323 **Leggett, Robert F.** Man as a geological agent: [Czechoslovakia] Ústřed. Ústav. Geol. Věstník, v. 43, no. p. 241–248, 1968.

Consequences of man's interference with his environment, both good and bad since Greek and Roman times, include: man-made karst, subsidence, or city foundation problems as in Paris, due to honey-combed underground workings; controlled coal mining, at Duisburg on the Rhine, where seams are overlain by marls that cushion subsidence due to lowering of river level by channel improvements; change of Suez Canal flow since impounding of Nile River by new High Dam at Aswan; correction of strip-mining effects; subsidence from pumping of ground water or petroleum reduced by ground-water recharge; stream diversion by canals, particularly in Canada and U.S.A.; peninsular growth where causeways interfere with littoral drift; and earth tremors near large hydraulic structures or major explosions. Many hidden geological features have been revealed by excavations. Future urbanization and possible climatic changes are considered.-GDC

01364 **LeMay, William J.** A perspective on Alaska's oil potential: Oil and Gas Jour., v. 67, no. 8, p. 114-120, illus., 1969.

Prospective petroleum reservoir rock varies from region to region in southern Alaska, but in general Tertiary marine and nonmarine sands are the prime exploration target, and in some areas Cretaceous marine sands. Few wells have been drilled in the vast interior region of the State where the major exploration objectives are Paleozoic and Mesozoic carbonates and sands. The most attractive reservoir characteristics in northern Alaska are found in the Mississippian Lisburne Formation and the Triassic Shublik Formation, the latter being the main pay at Prudhoe Bay containing reserves estimated at between 5 and 10 billion bbl of oil. Industry attention has focused on Cook Inlet basin and the North Slope; there are other geologically attractive basinal areas in Alaska, some of which have been explored only on a reconnaissance basis.-HHA

01468 **Lemmon, Robert E.** Chemical trends in the Salisbury granitic pluton, North Carolina [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 4, Southeastern Sec., p. 45, 1969.

**Lennox, D. H.** *See* Bukhari, S. A. 01292

01175 **Leonard, B. F.** Microindentation hardness of members of the ludwigite-vonsenite series, *in* Geological Survey research 1969, Chap. B: U.S. Geol. Survey Prof. Paper 650-B, p. B47-B52, illus., tables, 1969.

Microindentation hardness distinguishes members of the ludwigite-vonsenite series from one another and aids in estimating their $Fe^{+2}$ content. Microindentation hardness varies directly with Mg, inversely with $Fe^{+2}$. Locality, weight percent $Fe^{+2}$+ Mn (in parentheses), and mean $HV_{50}$ for four analyzed members are: Willis (0.5), 1254; Gorman (about 16), 952; Riverside (28.7), 956; Jayville (42.0), 838. Gorman ludwigite behaves anomalously. Composition and microindentation hardness for the four members are best related by the equation $x$=593.4-186.9 $\log_{10}y$, where $x$ is weight percent $Fe^{+2}$+ Mn, and $y$ is maximum $HV_{50}$. Qualitative properties of the indentations are of minor use in distinguishing the members.-Author's abstract

07297 **Leont'yev, O. K.; Luk'yanova, S. A.** Chenyer-plen kak geneticheskiy tip akkumulyativogo morskogo poberezh'ya: Moskov. Univ. Vestnik 1968, Geografiya, no. 4, p. 31-36, illus., 1968; English translation, Soviet Geography-Rev. and Translation, v. 9, no. 10, p. 864-872, illus., 1968.

The chenier plain of southwestern Louisiana is described on the basis of American literature and a personal visit. It is suggested that this is a distinctive type of accumulative coastland characterized by the alternation of marsh and beach ridges and formed by the pulsating influx of stream-borne and marine sediment and the alternating predominance of longshore and onshore transportation of sediment. The chenier plain of Louisiana is found to have analogs in the Guiana coast and in the Myzeqeja plain of Albania as well as in ancient, buried chenier deposits.-Authors' abstract

01208 **Lerbekmo, J. F.; Campbell, F. A.** Distribution, composition, and source of the White River Ash, Yukon Territory: Canadian Jour. Earth Sci., v. 6, no. 1, p. 109-116, illus., tables, 1969.

The ash is a bi-lobate, 1500-year-old deposit occupying six cubic miles and covering 125,000 sq mi of southern Yukon and eastern Alaska. Sixty samples were analyzed by X-ray fluorescence and petrographic analysis. The ash is rhyodacite composed of glass, andesine, hornblende, hypersthene, and magnetite. A synthesis of the distribution of the ash permitted the drawing of a 5×12 miles target source rectangle in the St. Elias Range between Mts. Natazhat and Bona in Alaska. Areal photographs revealed a suspect mound 0.4 miles in diameter beside the Klutlan Glacier and surface study showed the mound to be a flat cone of pumice. The vent lies beneath the glacier next to the cone.-*from* Authors' abstract

07229 **Lerbekmo, J. F.** Chemical and modal analyses of some Upper Cretaceous and Paleocene bentonites from western Alberta: Canadian Jour. Earth Sci., v. 5, no. 6, p. 1505-1511, illus., tables, 1968.

Twenty-two Cretaceous Brazeau Formation and 9 Paleocene Paskapoo Formation bentonites were analyzed. Petrographic modal analyses of 11 of the Brazeau samples were made for comparison. The original ashes were probably rhyodacites but ranged from dacites to rhyolites; a trend toward increasing acidity during the Cretaceous is recorded. The elemental composition of the bentonites shows no close quantitative relationships to the composition of the coarse crystal fraction. Alteration of the ashes to bentonites has resulted in preferential loss of Si over Al, and of Na over K. The chemical composition of the bentonites as a whole is controlled largely by the composition of the dominant clay mineral, montmorillonite, but original differences in composition between ashes are preserved to some degree.-*from* Author's abstract

01469 **Lesure, Frank G.** Residual enrichment and supergene transport of gold, Calhoun mine, Lumpkin County, Georgia [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 4, Southeastern Sec., p. 45-46, 1969.

01414 **Levy, John S.; Henry, Vernon J., Jr.** A mixed salt marsh estuary [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 4, Southeastern Sec., p. 46, 1969.

01176 **Lewis, G. Edward.** Larger fossil mammals and mylagaulid rodents from the Troublesome Formation (Miocene) of Colorado, *in* Geological Survey research 1969, Chap. B: U.S. Geol. Survey Prof. Paper 650-B, p. B53-B56, illus., 1969.

Two diagnostic fossil vertebrate faunas occur in the Troublesome Formation. One, lower stratigraphically and older, is equivalent to faunal elements of the *Merycochoerus* zone (Marsland Formation) of Nebraska. The second, higher stratigraphically and younger, is equivalent to faunal elements of the *Brachycrus* zone (Sheep Creek Formation) of Nebraska. If a twofold division of Miocene time be made, then these two faunas represent, respectively, the end of early Miocene time and late Miocene time. A third fauna, the precise age of which has not been determined as yet, may be somewhat older than the two diagnostic faunas.-Author's abstract

01068 **Libby, W. G.; Carpenter, John R.** Petrography and geochemistry of a mafic granofels in Newberry County, South Carolina: Southeastern Geology, v. 10, no. 2, p. 55-62, illus., tables, 1969.

A garnet-clinopyroxene-hornblende-plagioclase-rutile granofels is exposed in two road cuts about 4 mi south of Newberry, S. C. Accessories include opaques, sphene, apatite and epidote. The granofels shows discordant contact relationships with the enclosing country rock, a migmatitic quartz-biotite gneiss of the Charlotte Belt. Much, if not all, of the hornblende and plagioclase is a product of retrogressive alteration of a rock formerly consisting largely or entirely of clinopyroxene, garnet, rutile and opaques. Similarity of the retrogressive plagioclase-hornblende-garnet-epidote assemblage to that of typical mafic rocks of the Charlotte Belt suggests that this assemblage represents the final medium grade regional metamorphism in this area.-*from* Authors' abstract

**Lilley, E. M.** *See* Stephens, D. R. 01314

**Lilley, E. M.** *See* Stephens, D. R. 01315

**Lin, H. C.** *See* Foster, W. R. 01273

01223 **Lin, S. B.; Burley, B. J.** The system $CaF_2$-$CaMgSi_2O_6$: Canadian Jour. Earth Sci., v. 6, no. 2, p. 269-280, illus., table, 1969.

The solid-melt equilibria of the system $CaF_2$-$CaMgSi_2O_6$ (fluorite-diopside) have been studied at atmospheric pressure using a modified quenching method. This system is characterized by a simple binary eutectic at $CaF_2$ 43.5,$CaMgSi_2O_6$, 56.5 wt percent at 1082 ± 2°C; neither solid solution nor intermediate compound was found. Certain of the skarns containing fluorite, diopside and calcite in the Grenville province of the Canadian Precambrian shield are considered to have formed by differential melting of impure limestones in regional metamorphic terrains.-Authors' abstract

07150 **Lind, Aulis Olaf.** Coastal landforms of Cat Island, Bahamas-A study of Holocene accretionary topography and sea-level change [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 29, no. 3, p. 1059B-1060B, 1968.

**Lindsay, James R.** *See* Rose, Harry J., Jr. 01191

01257 **Lindsley, D. H.; Munoz, J. L.** Subsolidus relations along the join hedenbergite-ferrosilite: Am. Jour. Sci., v. 267-A (Schairer Volume), p. 295-324, illus., tables, 1969.

At pressures below 2 kb, hedenbergite clinopyroxenes on this join are stable over the compositional range from $Ca_{0.5}Fe_{0.5}SiO_3$ to a maximum Fe content of 0.60. Pyroxenes are not stable at low pressures in the zone of the pyroxene quadrilateral that extends from the ferrosilite apex about $Ca_{0.4}Fe_{0.6}SiO_3$ along the join and approximately to $Mg_{0.15}Fe_{0.85}SiO_3$ along the enstatite-ferrosilite join. The cessation of crystallization

of Ca-poor pyroxenes and the concomitant minimum in the Ca/(Ca+Mg+Fe) ratio of the coexisting Ca-rich pyroxenes in the Bushveld and Skaergaard intrusions probably is a function of the silica activity in each magma.-*from* Authors' abstract

01329 **Lockett, John B.** Sediment transport and diffusion-Columbia estuary and entrance-Closure [to discussion of paper 5601, 1967]: Am. Soc. Civil Engineers Proc., v. 95, paper 6374, Jour. Waterways and Harbors Div., no. WW 1, p. 108, 1969.

In closing the discussion of his paper [ibid., v. 93, no. WW 4, p. 167-175, 1967], the author states that the Pacific Northwest is fortunate in possessing exceptional planning capability in its resource development agencies. The problems mentioned by Bessey, including those of the upland Columbia, present opportunities to water resource planners.-ESL

01379 **Lomnitz, Cinna.** A definition of travel-time anomalies: Seismol. Soc. America Bull., v. 59, no. 1, p. 421-425, illus., 1969.

Plotting the seismic traveltime from a point as a function of azimuth and distance yields a surface called a "chronoid". The chronoid for the standard Earth is a surface of revolution, termed the "standard chronoid." Local anomalies are defined as the set of coordinate transformations required to bring the local chronoid into least-square coincidence with the standard chronoid. In general this is accomplished by means of two mutually orthogonal translations, plus one rotation in an azimuthal plane. These operations give rise to three distinct components of the local anomaly; a geophysical interpretation of each of the anomaly components is provided.-Author's abstract

**Loncarevic, B. D.** *See* Aumento, F. 01214

01388 **Long, Leland Timothy; Berg, Joseph W., Jr.** Transmission and attenuation of the primary seismic wave, 100 to 600 km: Seismol. Soc. America Bull., v. 59, no. 1, p. 131-146, illus., tables, 1969.

The observed frequency dependence of attenuation can be used to calculate Q values which are independent of losses due to geometric spreading or reflections at boundaries. Apparent rates of attenuation in terms of $Q_{ap}$ along two refraction lines were computed to be 169 ± 42 at 5 cps in eastern New Mexico and 116 ± 38 at 4 cps in Nevada; the geometric spreading factor satisfying amplitudes and $Q_{ap}$ values is $r^{-0.5}$. Thus, the primary seismic wave at epicentral distances of 100 to 600 km appears to be a continuous refraction. Attenuation is the dominant factor in determining waveform, spectral content, and amplitude of the first arrival. A Q of 100 implies a functional relation between frequency and distance which shows that amplitudes at frequencies above 4 cps at 150 km and above 3 cps at 400 km will be less than one tenth the peak spectral amplitude and cannot be reliably related to the source.-*from* Authors' abstract

01242 **Loose, Timothy L.** Ecology of intertidal Foraminifera, Bodega Head, Sonoma County, California [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 3, Cordilleran Sec., p. 37-38, 1969.

**Loucks, Gerald G.** *See* Bolyard, Dudley W. 07267

**Louis, Hedley.** *See* Stephens, D. R. 01314

**Louis, Hedley.** *See* Stephens, D. R. 01315

01186 **Lovering, Tom G.** Distribution of minor elements in samples of biotite from igneous rocks, *in* Geological Survey research 1969, Chap. B: U.S. Geol. Survey Prof. Paper 650-B, p. B101-B106, illus., tables, 1969.

Two hundred samples of biotite taken from several types of igneous rocks from many localities have been analyzed by a semiquantitative spectrographic method in the laboratories of the U.S. Geological Survey. Thirty-six minor elements were detected

in one or more of these samples. Ca, Na, Ti, Mn, Ba, Co, Cr, Cu, V, Sc, Ni, and Sr were detected in more than 90 percent of the samples. Biotite samples from different parent rock types show corresponding differences in concentrations of minor elements. Biotite from granitic pegmatite and pyroclastic rocks contains detectable Mo, and biotite from syenite and nepheline syenite commonly contains Ag.-Author's abstract

01461 **Lowry, W. D.** Are we on the right track? [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 4, Southeastern Sec., p. 46-47, 1969.

**Lubke, E. R.** *See* Takasaki, K. J. 01316

01206 **Luiz, A. M.** Gravity variations and precipitation: Canadian Jour. Earth Sci., v. 6, no. 1, p. 190-192, illus., table, 1969.

The effects of gravity variations on precipitation are discussed. It is shown that the most probable time of rainfall may coincide with the time of maximum rate of change of the Earth's gravitational field.-Author's abstract

**Luk'yanova, S. A.** *See* Leont'yev, O. K. 07297

07170 **Lundgren, L.** Blastomylonites in eastern Connecticut (U.S.A.) [abs.]: Geol. Fören. Stockholm Förh., v. 90, pt. 3, no. 534, p. 464, 1968.

**Lundgren, Lawrence W., Jr.** *See* Dixon, H. Roberta. 07243

01278 **Luth, W. C.** The systems $NaAlSi_3O_8$-$SiO_2$ and $KAlSi_3O_8$-$SiO_2$ to 20 kb and the relationships between $H_2O$ content, $P_{water}$, and $P_{total}$ in granitic magma: Am. Jour. Sci., v. 267-A (Schairer Volume), p. 325-341, illus., tables, 1969.

In both systems the eutectic liquid is enriched in the feldspar component with increasing pressure. The observed shift in eutectic composition with increasing pressure is similar in direction to that previously found for the eutectic liquids in the systems $NaAlSi_3O_8$-$SiO_2$-$H_2O$ and $KAlSi_3O_8$-$SiO_2$-$H_2O$ at pressures to 10 kb. This information is used in conjunction with available data on the system $NaAlSi_3O_8$-$KAlSi_3O_8$-$SiO_2$-$H_2O$ to demonstrate that $P_{total}$ and $P_{water}$ must be treated as independent variables in the quaternary system. Consequently the implicit assumption employed by some investigators in the application of experimental studies to specific granites, that pressure affects the equilbria only through the variable $P_{water}$, is invalid.-*from* Author's abstract

**Luttrell, Gwendolyn W.** *See* Kover, Allan N. 01464

**Lyall, Anil K.** *See* Gees, Rudolf A. 01230

07250 **Lyons, J. B.; Faul, H.** Isotope geochronology of the northern Appalachians, Chap. 23 *in* Studies of Appalachian geology, northern and marine (Zen, E-an, and others, editors): New York and London, Interscience Publishers, p. 305-318, illus., tables, 1968.

Isotopic dating of igneous and metamorphic rocks of the Precambrian, Cambrian, Ordovician, Silurian, Devonian, Carboniferous, Triassic, Jurassic(?), and Cretaceous of New England and the Maritime Provinces is reviewed. Correlations between major tectonism and major plutonism appear to be more than mere coincidence, and times of volcanism precede times of intrusion. The most important event in the region was the Acadian orogeny.-JWC

**MacClintock, Copeland.** *See* Pannella, Giorgio. 07325

01225 **Macdougall, J. Douglas; Harriss, Robert C.** The geochemistry of an Arctic watershed: Canadian Jour. Earth Sci., v. 6, no. 2, p. 305-315, illus., tables, 1969.

The clays and elemental chemistry of soil and sediments from a small area in the Canadian Arctic Archipelago were examined. The clay mineralogy reflects a physical weathering regime. Sedimentation rates of Mn in the near-shore sediments are similar to pelagic sediments of other oceans. Mineral-water reactions during transition from the terrestrial to marine environment are limited to ion-exchange reactions. The K:Rb ratio of the sediments is higher than that of the source area soils. Little or no boron is taken up by clays as they enter the marine environment. New data on Hg, Pd, and Au in near-shore sediments are presented; the values are 30, 2.1, and 2.7 ppb, respectively.-*from* Authors' abstract

01264 **MacGregor, Ian D.** The system $MgO$-$SiO_2$-$TiO_2$ and its bearing on the distribution of $TiO_2$ in basalts: Am. Jour. Sci., v. 267-A (Schairer Volume), p. 342-363, illus., tables, 1969.

The following univariant reactions occur between 1 atm and 40 kb: (1) En + M = Fo + 2Rt; (2) $L_2$ = Fo + En + M; (3) $L_3$ + Fo = M + En; (4) $L_4$ = M + En + Rt; (5) $L_5$ + M = Fo + Rt; (6) $L_6$ = Fo + En + Rt; (7) $L_7$ = M + Fo + Rt (where En = $MgSiO_3$, M = $MgTi_2O_5$, Fo = $Mg_2SiO_3$, Rt = $TiO_2$, $L_n$ = liquid). The results of discriminant function analysis suggests that $TiO_2$ is by far the best oxide in distinguishing between Cenozoic basalts from oceanic island and circumoceanic localities. Comparison of the experimental compositions with those of Cenozoic basalts suggests that successful geographic division into oceanic island and circumoceanic environments is related more to the tectonic setting than regional geochemical variations.-*from* Author's abstract

01462 **Macintyre, I. G.; Pilkey, O. H.; Blackwelder, B. W.** Modern hermatypic reef corals on Miocene outcrops on the North Carolina continental shelf [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 4, Southeastern Sec., p. 47, 1969.

**MacKenzie, W. S.** *See* Rahman, S. 01256

01224 **MacRae, N. D.** Ultramafic intrusions of the Abitibi area, Ontario: Canadian Jour. Earth Sci., v. 6, no. 2, p. 281-303, illus., tables, 1969.

In general, the bodies are sill-like and are differentiated into major layers of peridotite, clinopyroxenite, and gabbro, generally in that stratigraphic order. They fall into four groups: (1) complex sills, (2) simple differentiated sills, (3) bodies of dunite and peridotite only, and (4) bodies of gabbroic rocks only. The chilled margins of one of the group (2) bodies are similar in composition to tholeiitic basalt. The intrusions are differentiated from a basaltic magma by gravity controlled fractionation. In some the fractionation and intrusion was periodic, hence the multiple sills. For the other bodies, large amounts of partly crystallized liquid were expelled and all are entirely or largely ultramafic. The gabbro bodies were derived from the expelled magma.-HRC

01463 **Malcolm, Ronald L.** Ionic-scavenging ability of organic matter [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 4, Southeastern Sec., p. 47-48, 1969.

07307 **Malkin, N. R.** The retreat of the North American ice sheet and shifts in cyclone tracks: Soviet Geography-Rev. and Translation, v. 9, no. 10, p. 872-881, illus., 1968; originally published in Russian, 1966.

This paper was originally published in Vses. Geog. Obshch. Izv., v. 98, no. 4, p. 326-332, 1966. *See* Abstracts of North American Geology for December 1967.

01286 **Mamay, Serguis H.** Cycads-Fossil evidence of late Paleozoic origin: Science, v. 164, no. 3877, p. 295-296, illus., 1969.

Plant fossils from Lower Permian strata of the southwestern United States have been interpreted as cycadalean megasporophylls. They are evidently descended from spermopterid elements of the Pennsylvanian *Taeniopteris* complex; thus the known fossil historyof the cycads is extended from the Late Triassic into the late Paleozoic. Possible implications of the Permian fossils toward evolution of the angiosperm carpel are considered.-Author's abstract

01415 **Mann, Virgil Ivor.** Gravity patterns over some igneous intrusives in the Piedmont of North Carolina [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 4, Southeastern Sec., p. 48, 1969.

07294 **Manten, A. A.; DeMunter-Thompson, D. V.** Grove Karl Gilbert (1843-1918): Earth-Sci. Rev., v. 4, no. 4, p. A260-A262, 1968.

07276 **Marchant, L. C.; White, E. J.** Comparison of log and core analysis results for an extremely heterogeneous carbonate reservoir, *in* SPWLA Logging Symposium, 9th Ann., New Orleans, La., 1968, Trans: Houston, Tex., Soc. Prof. Well Log Analysts, p. L1-L16, illus., tables, 1968.

Accurate evaluation of Williston Basin carbonate reservoirs is difficult due to the extreme heterogeneity of the carbonate rock. Log and core analysis results for the Ratcliffe interval of the Madison formation in Montana's Flat Lake oil field were compared. Sonic and resistivity log porosities averaged 10 percent greater and 11 percent less, respectively, than the corresponding core porosities. Water saturations derived from both sonic and resistivity logs were consistently lower than the corresponding core residual water saturations.-*from* Authors' abstract

01443 **Marine, I. W.; Webster, D. S.; Proctor, J. F.** Two-well tracer test in fractured crystalline rock [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 4, Southeastern Sec., p. 48-49, 1969.

**Mark, Anson.** *See* Gerhard, Lee C. 07266

01444 **Marshall, Nelson.** The effect of the interstitial community on the properties of sediments in shoal estuarine environments [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 4, Southeastern Sec., p. 50, 1969.

**Mason, R.** *See* Anhaeusser, C. R. 07331

07260 **Matson, Roger M.; Schneider, Richard C.** Oil and gas exploration in southeastern Colorado, *in* Guidebook issue, southeastern Colorado: Mtn. Geologist, v. 5, no. 3, p. 89-94, illus., table, 1968.

The 1965 discovery of commercial Mississippian oil on the Las Animas arch in southeast Colorado has rejuvenated exploration and drilling activity. Previous exploration dealt largely with Permo-Pennsylvanian objectives similar to the vast and numerous gas and oil reservoirs in southwest Kansas and the panhandles of Texas and Oklahoma. The pay zones in southeast Colorado's 20 oil and gas fields are shallow and range from Mississippian in age. Drilling to date is sparse, thus leaving ample room for exploration for major new reserves. It is anticipated that subsurface stratigraphic and structural mapping and multifold seismic mapping will reveal the most definitive drilling prospects. Other structural data that can support subsurface interpretations are the dipmeter and surface data, e.g. photogeology. Well evaluations and completions are often difficult due to the low pressure reservoirs that are common in the area.-Authors' abstract

01445 **Matthews, Vincent, 3d.** The Gladesville Norite and its relationship to similar mafic plutons in the Georgia Piedmont [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 4, Southeastern Sec., p. 50, 1969.

07193 **Mawby, John Evans.** Pliocene vertebrates and stratigraphy in Stewart and Ione Valleys, Nevada [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 29, no. 4, p. 1406B, 1968.

07301 **Maxwell, John A.** Rock and mineral analysis: New York and London, Interscience Publishers (Chemical analysis, V. 27), 584 p., illus., tables, 1968.

This book is an attempt to provide literature references on rock and mineral analyses accumulated since 1950, and to restate classical methods and techniques of analysis in their present refined and modified form. The four parts are: (1) preliminary considerations-nature of analysis, precision and accuracy, sampling and sample prepara-

tion, working environment, decomposition of sample; (2) methods of analysis-discussion of silicates, carbonates, and others; (3) methods of analysis-selected procedures for silicates and carbonates; (4) special methods of analysis-X-ray emission spectrography, atomic absorption spectroscopy. Appendixes contain schemes for: conventional silicate rock analysis (fluorine<2 percent), rapid chemical analysis of silicate rocks, and combined X-ray fluorescence-chemical rapid analysis of silicate rocks.-MCM

**Mays, Robert E.** *See* Lee, Donald E. 01174

**McClymonds, N. E.** *See* Cohen, Philip. 01347

07194 **McCormick, Charles Larry.** Holocene stratigraphy of the marshes at Plum Island, Massachusetts [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 29, no. 4, p. 1406B, 1968.

01064 **McCormick, J. E.; Evans, L. L.; Palmer, R. A.; Rasnick, F. D.; Quarles, K. G.; Mellon, W. V.; Riner, B. G.** Mine geology of the American Zinc Company's Young mine, *in* Papers on the stratigraphy and mine geology of the Kingsport and Mascot formations (Lower Ordovician) of East Tennessee: Tennessee Div. Geology Rept. Inv. 23, p. 45-52, illus., 1969.

The Young mine, in Jefferson County, contains zinc deposits primarily in the lower part of the Kingsport Formation. The mine is atop the Hodges dome which has been displaced on the north flank by a high-angle, post-ore reverse fault. The ore-controlling structures that house the zinc mineralization are collapse-breccia structures which are irregular in shape and vary greatly in size. Limestone was locally recrystallized to dolomite and the consequent volume reduction resulted in collapse of overlying beds. Various structural features resulted from the collapse stresses. Light yellow sphalerite is the principal mineral generally associated with dolomite gangue.-HRC

01344 **McCrossan, R. G.** An analysis of size frequency distribution of oil and gas reserves of western Canada: Canadian Jour. Earth Sci., v. 6, no. 2, p. 201-211, illus., table, 1969.

Oil and gas reserves of western Canada are log-normally distributed. If the total reserves are separated into groups made up of single types of occurrence, these all display log-normal distribution also. The parameters of distribution vary considerably for different groups of genetically related accumulations. Many distributions also appear to be heterogeneous. The reasons may be that the reserves for small pools may be underestimated for lack of data, and geologically unlike pools may be grouped together. The distribution curves for the total reserves show only a generalized picture and obscure the characteristics of the individual distributions of the several types of oil and gas accumulations.-*from* Author's abstract

07279 **McCulloh, T. H.; Kandle, J. R.; Schoellhamer, J. E.** Application of gravity measurements in wells to problems of reservoir evaluation, *in* SPWLA Logging Symposium, 9th Ann., New Orleans, La., 1968, Trans.: Houston, Tex., Soc. Prof. Well Log Analysts, p. O1-O29, illus., table, 1968.

Borehole gravity meters suitable for logging formation density consist of single high-sensitivity gravity sensors operated on conventional multiconductor well-logging wireline. Discontinuous logs of gravity versus depth result. Average interval formation densities are calculated from vertical gradients of gravity by simple inverse proportionality. A deep well in Santa Fe Springs oil field, California, was surveyed during gravimeter tests. Unsuccessful and successful recompletion attempts in a nearby well confirmed that the technique has the capability of detecting anomalously low density undetected oil- and gas-bearing zones. Careful interpretation permits distinguishing between more dense water-saturated zones, and less dense depleted secondary gas caps.-*from* Authors' abstract

**McDonald, Harris R.** *See* Phillips, H. Boyd. 01375

**McEachin, W. D.** *See* Foster, Norman H. 07263

**McGrain, Preston.** *See* Dever, Garland R. 01408

01201 **McGrath, Peter H.; Hall, Donald H.** Crustal structure in northwestern Ontario-Regional magnetic anomalies: Canadian Jour. Earth Sci., v. 6, no. 1, p. 101-107, illus., 1969.

A regional aeromagnetic map in Ontario from 92° to 97° W. and from 50° to 50° N. and another smaller block to the west, is presented. The map is from multiple application of two-dimensional smoothing operator applied to data digitized at 3 km intervals. Comparison with maps from other techniques shows that the anomaly patterns were found to be similar for all techniques. The regional anomaly system is related in some cases to the thickness of the upper crust layer (above the Intermediate seismic discontinuity) and to structure within it, but not to the lower crustal layer or to the upper mantle.-HRC

01312 **McGreevy, Laurence J.; Hodson, Warren G.; Rucker, Samuel J., 4th.** Groundwater resources of the Wind River Indian Reservation, Wyoming: U.S. Geol. Survey Water-Supply Paper 1576-I, p. I1-I145, illus., tables, geol. map, 1969.

Potential yield and quality of ground water in this Reservation are estimated as follows: more than 1,000 gpm from Ordovician Bighorn Dolomite, Devonian Darby Formation, Mississippian Madison Limestone, and Pennsylvanian Tensleep Sandstone (dissolved solids from 300-3,000 ppm). Yields of several hundred gpm are possible from Jurassic and Triassic formations with dissolved solids generally high; Cretaceous and Jurassic rocks may yield several hundred gpm; Tertiary and Quaternary formations yield from a few to several hundred gpm. Methods of improving drainage in a waterlogged irrigation project are suggested.-*from* Authors' abstract

01072 **McGregor, Don L.; Kesling, Robert V.** Copulatory adaptations in ostracods-Pt. 1, Hemipenes of *Candona*: Michigan Univ. Mus. Paleontology Contr., v. 22, no. 13, p. 169-191, illus., table, 1969.

Hemipenes of the living freshwater cypridid ostracod *Candona* consist of numerous elements, which are identified and described from dissections and microtome sections. Morphology of hemipenes and dimorphism of carapace are strongly interrelated. Dimorphism in *Candona* involves an enlarged posteroventral region in the male (to house the voluminous hemipenes) and a truncated posterodorsal region in the female (to facilitate mating in a posterodorsal position). The same kind of dimorphism exists in fossil species of *Candona*(Pennsylvanian?-Pleistocene), suggesting that form of sex organs and mating procedure similar to that in extant species developed early in the history of the genus and persisted during its evolution.-*from* Authors' abstract

01076 **McGregor, Don L.; Kesling, Robert V.** Copulatory adaptations in ostracods-Pt.2, Adaptations in living ostracods: Michigan Univ. Mus. Paleontology Contr., v. 22, no. 17, p. 221-239, illus., 1969.

Literature on living ostracods contains only scattered and incomplete information of the genitalia and mating behavior. Most observations are directed more toward form than toward function; many are based on dissected, unoriented, and distorted material. A review of current knowledge reveals several adaptations for copulation to carapace morphology. These generalizations may prove useful in interpreting similar features of extinct ostracods.-Authors' abstract

**McKee, Bates.** *See* Association Eng. Geologists. 07212

07213 **McKee, Bates.** The northwestern part of the Columbia Plateau, *in* Assoc. Eng. Geologists, 1968 Natl. Mtg., Seattle, Wash., 1968, Guidebook to field trips: [Sacramento, Calif.] Assoc. Eng. Geologists, p. 4-10, 1968.

The late Miocene Columbia River Group of lava flows rests unconformably upon the Eocene Swauk Formation; this in turn rests upon pre-Cenozoic gneisses of the Cascade Mountains. The basalt group is divided into the Yakima Basalt and the Picture Gorge Basalt, the latter being from the John Day basin area in Oregon. Some of

the individual flows are very extensive, indicating great fluidity. Pleistocene, probably Wisconsin, glacial features lie atop the basalt; several different types in several different places are mentioned.-HRC

07218 **McKee, Bates.** The central and southern Cascades, *in* Assoc. Eng. Geologists, 1968 Natl. Mtg., Seattle, Wash., Guidebook to field trips: [Sacramento, Calif.] Assoc. Eng. Geologists, p. 31-45, 1968.

Pre-Cenozoic rocks are metamorphic, including the Easton Schist (Paleozoic), and graywacke sandstones and siltstones and greenstones which are probably Paleozoic or Mesozoic; Eocene arkose and associated volcanics overlie the metamorphic basement. No thickness is known, but the section is similar to the 30,000 ft Eocene section in the eastern Cascades. These rocks are overlain by late Eocene to Miocene volcanic strata almost 30,000 feet thick and about which very little is known. Miocene intrusions of granodiorite and structural deformation followed; K-Ar dates show the intrusions to be 17.0 m.y. old. The Yakima Basalt overlies the folded rocks and is late Miocene; this is overlain by the Pliocene Ellensburg Formation. Volcanic cones are Quaternary.-HRC

07219 **McKee, Bates.** The destruction of Mount Rainier, *in* Assoc. Eng. Geologists, 1968 Natl. Mtg., Seattle, Wash., Guidebook to field trips: [Sacramento, Calif.] Assoc. Eng. Geologists, p. 46-52, 1968.

The cone is deeply scarred by glacial action, and much material has been carried from the cone downward, to be removed by streams. Mudflows are also very active, and over 50 million cubic yards of material are known to have been removed during one flow. Debris flows are also recognized, one of which moved 400-500 million cubic yards of material. The Osceola mudflow is the largest of its kind in the world, and contains over 1.5 billion cubic yards of material. Rock avalanches are known to fall on the ice and travel great distances.-HRC

07220 **McKee, Bates.** Glaciation of the Puget Lowland, *in* Assoc. Eng. Geologists, 1968 Natl. Mtg., Seattle, Wash., Guidebook to field trips: [Sacramento, Calif.] Assoc. Eng. Geologists, p. 53-57, illus., 1968.

The area was covered by ice which came from the north from the Fraser lowland of British Columbia. The four advances are (from oldest to youngest) the Orting, Stuck, Salmon Springs, and Fraser. The intervening intervals are the Alderton, Puyallup, and Olympia. The ages of the older glaciations are uncertain, but the Orting and Stuck are probably early and/or Middle Pleistocene; Salmon Springs is assigned an early Wisconsin age, and the Fraser to Late Wisconsin. The last stage of the Fraser is the Vashon stade and during its maximum it stood a few miles south of Olympia. Ice was 3,500 feet deep over Seattle and was about a mile thick in places. The Vashon stade was very short-lived.-HRC

07226 **McKee, Bates.** The Northern Cascades, *in* Assoc. Eng. Geologists, 1968 Natl. Mtg., Seattle, Wash., Guidebook to field trips: [Sacramento, Calif.] Assoc. Eng. Geologists, p. 85-97, 1968.

The area was the site of eugeosynclinal deposition during the Paleozoic and Mesozoic. The crystalline basement consists of the Chilliwack Group of late and middle Paleozoic age, and the Cascade metamorphic suite of late Paleozoic age; metamorphism was pre-Jurassic and may have been Permian. Jurassic and Cretaceous sedimentary rocks are preserved in the Methow-Pasayten graben; their thickness is more than 30,000 feet. Deformation occurred in the late Cretaceous and shows as folding, faulting, and metamorphism. The Chukanut Formation, of Eocene age, overlies the others and may be over 20,000 feet thick. This is the youngest material save for the Pleistocene volcanoes. Granitic intrusions occurred during the Devonian, Permian, and Cretaceous, the latter being of enormous volume.-HRC

**McKee, Edwin H.** *See* Armstrong, Richard L. 01250

01446 **McLeroy, Donald F.** Limiting mineral exploration targets based on the tectonic evolution of the Mexican Geosyncline [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 4, Southeastern Sec., p. 50-51, 1969.

**McManus, Dean A.** *See* Venkatarathnam, K. 01239

01447 **McSween, Harry Y., Jr.** The partitioning of transition metals in low temperature systems [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 4, Southeastern Sec., p. 51, 1969.

**McWilliams, J. R.** *See* Bur, T. R. 01377

01448 **Meade, Robert H.** Sediment transport and deposition as controlled by estuarine hydraulics-Examples from the Savannah and Mississippi Rivers [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 4, Southeastern Sec., p. 51-52, 1969.

**Mears, Connally E.** *See* Krivoy, Harold L. 01189

01449 **Medlin, Jack H.** Petrology of two mafic igneous complexes in the South Carolina Piedmont [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 4, Southeastern Sec., p. 52, 1969.

07195 **Mehringer, Peter J.** Pollen analysis of the Tule Springs site, Nevada [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 29, no. 4, p. 1406B-1407B, 1968.

07309 **Meighan, Clement W.; Foote, Leonard J.; Aiello, Paul V.** Obsidian dating revisited [reply to discussion, 1968, by I. Friedman and C. Evans of 1968 paper]: Science, v. 162, no. 3855, p. 814, 1968.

The principal point of the criticism by Friedman and Evans (ibid., p. 813-814) of the use by Meighan, Foote, and Aiello (ibid., v. 160, no. 3832, p. 1069-1075, 1968) of a linear formula for the hydration rate of obsidian artifacts from western Mexico is that the Friedman formula is so firmly established by empirical evidence that use of any other rate will lead to erroneous results. Meighan and his colleagues do not believe it so securely established. Archeologists are not unanimous in accepting any specific rate formula. The linear hydration rate was developed to fit the archeological evidence; Friedman and Evans conversely suggest a reinterpretation of western Mexican archeology to fit the Friedman hydration rate. Specific points of the criticism are answered.-DBV

**Mellon, W. V.** *See* McCormick, J. E. 01064

01389 **Mereu, R. F.; Hunter, J. A.** Crustal and upper mantle structure under the Canadian Shield from Project Early Rise data: Seismol. Soc. America Bull., v. 59, no. 1, p. 147-165, illus., tables, 1969.

The structure of the Earth's crust and upper mantle under the Canadian Shield as determined by the Project Early Rise seismic experiment of 1966 is presented. The traveltime graph had 3 branches showing apparent velocities of 6.3 kmps up to 2.4°, 8.10 kmps from 2.4° to 5.8°, and 8.54 kmps from 5.8° to 13.4°. When corrected for curvature the latter two velocities were found to be 8.05 and 8.43 kmps respectively with the higher velocity occurring at a depth of approximately 84 km. The unusually thick 50 km crust under Lake Superior is not extensive. There may be a slight decrease in P-wave velocity at a depth of 95 km.-*from* Authors' abstract

01192 **Meyrowitz, Robert.** The direct microdetermination of silicon and aluminum in silicate minerals, *in* Geological Survey research 1969, Chap. B: U.S. Geol. Survey Prof. Paper 650-B, p. B136-B139, table, 1969.

The $SiO_2$ and $Al_2O_3$ contents of 3- to 5-mg samples of common silicate minerals are directly determined spectrophotometrically by using molybdenum blue and Alizarin Red-S procedures, respectively. The samples are decomposed by sodium hydroxide fusion, and hydrochloric acid solutions of the melts are used for the determinations.

The common rock-forming elements likely to be present in most silicate minerals do not interfere in the $SiO_2$ determinations. Fluorine in concentrations most likely to be found does not interfere in the $Al_2O_3$ determinations. Titanium and iron interference is overcome by adding the amounts of titanium and iron present in the sample to the standard aluminum solutions used to prepare the standard aluminum curve.-Author's abstract

**Miget, R. J.** *See* Brogden, W. B. 01407

01450 **Mikesh, D. L.; Howard, James D.** The Arnhem bedload discharge sampler as a device for securing bedload data from the continental shelf [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 4, Southeastern Sec., p. 52-53, 1969.

01451 **Milici, Robert C.** Nonmarine deposition of basal Pennsylvanian strata in the southeastern Cumberland Plateau of Tennessee [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 4, Southeastern Sec., p. 53, 1969.

**Miller, H. W.** *See* Crawford, Johnson. 01066

**Milliman, John.** *See* Pilkey, Orrin H. 01436

**Mills, W. R.** *See* Hilchie, D. W. 07281

01452 **Milton, Charles; Grasty, Robert.** Igneous and metamorphic rocks of Florida [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 4, Southeastern Sec., p. 54, 1969.

**Minihan, E. D.** *See* Oxley, Marvin L. 01363

01453 **Mitterer, Richard M.** The origin of calcareous oolites [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 4, Southeastern Sec., p. 54-55, 1969.

01305 **Moen, Wayne S.** Mines and mineral deposits of Whatcom County, Washington: Washington Div. Mines and Geology Bull. 57, 134 p., illus., tables, geol. map, 1969.

About 85 percent of Whatcom County is part of the North Cascade Mountains; the western section is part of the Puget Lowlands. Relative inaccessibility and adverse weather conditions have hampered development of mineral resources. Main mineral production has been nonmetallic-coal, limestone, sand and gravel, clay, peat, building stone, quartz, and olivine. Metallic mineral production has been mainly gold. Current production is limestone, sand and gravel, olivine, and stone. Olivine reserves are the greatest in the United States; most other reserves are moderate, and those of silver, copper, lead, and zinc are small. Recent rocks are sources for sand, gravel, common clay; lower Tertiary for coal, stone, and fire clays; Cretaceous for iron and building stone; Permian to Devonian for limestone; and Tertiary for olivine and metals.-*from* Author's abstract

**Moench, R. H.** *See* Osberg, P. H. 07245

01241 **Moiseyev, A. N.** Importance of a non-magmatic source of mercury in quicksilver ore deposits [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 3, Cordilleran Sec., p. 43, 1969.

07209 **Money, P. L.** The Wollaston Lake fold-belt system, Saskatchewan-Manitoba: Canadian Jour. Earth Sci., v. 5, no. 6, p. 1489-1504, illus., tables, 1968.

This major feature of the Churchill province consists of coalescing fold belts collectively traced for 400 miles. They formed during the Hudsonian orogeny and consist of tightly to isoclinally folded metamorphic and migmatitic rocks. The metamorphic rocks are the Daly Lake, Sandfly Lake, and Meyers Lake Groups. The Daly Lake is miogeosynclinal, and the Sandfly Lake Group is eugeosynclinal, but their relations are uncertain. The Meyers Lake Group resembles a stable shelf assemblage and overlies the Sandfly Lake Group, probably unconformably. Daly Lake Group-like rocks form most of the fold belts. All rocks in the fold belts belong to the amphibolite fa-

cies, and ore mineralization is widespread but currently uneconomical. The most prominent zone of magnetic anomalies in the Precambrian of Saskatchewan coincides in part with the fold belt system.-*from* Author's abstract

07154 **Montgomery, Joseph Hilton.** Petrology, structure and origin of the Copper Mountain intrusions near Princeton, British Columbia [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 29, no. 3, p. 1064B, 1968.

**Moore, George E., Jr.** *See* Quinn, Alonzo W. 07247

01187 **Moore, H. J.** Subsurface deformation resulting from missile impact, *in* Geological Survey research 1969, Chap. B: U.S. Geol. Survey Prof. Paper 650-B, p. B107-B112, illus., table, 1969.

Partial excavation of craters produced in indurated gypsum and alluvium by missiles with oblique trajectories revealed five distinct zones of deformation: (1) mixed breccia, (2) sanded material, (3) a zone of conjugate fractures, (4) tilted and broken material, and (5) a zone of open fractures. These zones, which are similar to those produced by explosives in natural materials, are distributed with bilateral symmetry about the plane of the missile trajectory. The sizes of the mixed breccias are in reasonable agreement with predictions using simple scaling laws derived from data on mixed breccias produced by explosives. The scaling laws do not, however, predict the difference in sizes of the mixed breccias of craters in gypsum and craters in alluvium.-Author's abstract

**Moore, Michael C.** *See* Sandberg, Philip A. 01425

**Moorhouse, W. W.** *See* Lal, R. K. 01202

**Moorhouse, W. W.** *See* Cooke, D. L. 01209

**Morales-Alamo, Reinaldo.** *See* Haven, Dexter S. 01474

**Morales-Alamo, Reinaldo.** *See* Haven, Dexter S. 01475

**Morin, R. W.** *See* Bandy, O. L. 01287

07282 **Morris, Billy P.; Cocanower, R. D.** Computers-To increase the value of temperature logs, *in* SPWLA Logging Symposium, 9th Ann., New Orleans, La., 1968, Trans.: Houston, Tex., Soc. Prof. Well Log Analysts, p. R1-R21, illus., 1968.

The use of digital recording and computer analysis, coupled with logging technique, allows the selection of meaningful temperature data exclusive of the masking effects inherent in regular logging methods. Extrapolation provides a means of projecting this "pure" data to established reference indices, resulting in an accurate injection water distribution pattern from temperature logs. Field examples are presented comparing the various temperature logging techniques with the computerized logs.-KAF

01454 **Morton, Robert W.** Spatial and temporal observations of suspended sediment-Narragansett Bay and Rhode Island Sound [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 4, Southeastern Sec., p. 55, 1969.

**Muan, A.** *See* Woermann, E. 01271

01170 **Mullineaux, D. R.; Sigafoos, R. S.; Hendricks, E. L.** A historic eruption of Mount Rainier, Washington, *in* Geological Survey research 1969, Chap. B: U.S. Geol. Survey Prof. Paper 650-B, p. B15-B18, illus., 1969.

A sparsely distributed pumice that has not previously been recognized was erupted by Mount Rainier, Wash., in the 19th century. It is similar mineralogically to a more widespread and voluminous older pumice, and it has been identified only on moraines and terraces that postdate the older pumice. Limiting dates of its eruption have been obtained from a complex of Emmons Glacier end moraines. Ages of trees

on moraines older and younger than the pumice indicate that the eruption occurred between 1820 and 1854.-Authors' abstract

**Munoz, J. L.** *See* Lindsley, D. H. 01257

**Murray, D. Keith.** *See* Foster, Norman H. 07263

07299 **Musgrove, R. H.; Foster, J. B.; Toler, L. G.** Water resource records of the Econfina Creek basin area, Florida: Florida Div. Geology Inf. Circ. 57, 127 p., illus., tables, 1968.

The Econfina Creek basin in northwestern Florida has an abundant supply of ground water and surface water of good quality. In addition to information on surface water, tabulated data include records of wells, measurements of ground-water levels, pumping test data, lithologic logs of selected wells, records of ground-water pumpage, chemical analyses and temperature of ground water, and periodic chloride analyses and temperature of water from wells.-MCM

**Mustonen, E. D.** *See* Sass, J. H. 07230

07196 **Mutschler, Felix Ernest.** Geology of the Treasure Mountain dome, Gunnison County, Colorado [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 29, no. 4, p. 1407B-1408B, 1968.

01455 **Myers, Paul B., Jr.** Development of the Hamburg klippe in the Bernville-Strausstown area, Pennsylvania [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 4, Southeastern Sec., p. 55-56, 1969.

07197 **Naeser, Charles Wilbur.** Fission track age relationships in a contact zone, Eldora, Colorado [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 29, no. 4, p. 1408B, 1968.

07244 **Naylor, Richard S.** Origin and regional relationships of the core-rocks of the Oliverian domes, Chap. 17 *in* Studies of Appalachian geology, northern and marine (Zen, E-an, and others, editors): New York and London, Interscience Publishers, p. 231-240, illus., 1968.

The core rocks of the Oliverian domes in the Connecticut Valley region are volcanic and plutonic rocks of probable Ordovician age. These rocks are an integral part of a larger belt of Ordovician volcanic and plutonic rocks in the central part of the northern Appalachian geosyncline. About one quarter of the Mascoma dome of west-central New Hampshire is underlain by unstratified rocks with cross-cutting relationships. Field and geochronologic data indicate that these rocks were intruded prior to the deposition of the Lower Silurian units that mantle the dome; none of the important cross-cutting relationships appear to be due to remobilization during later orogeny. The remaining core rocks of the Mascoma dome and other Oliverian domes are weakly stratified and are interpreted as metavolcanics.-JWC

07155 **Neal, William Joseph.** Petrology and paleogeography of the Blackjack Creek Formation (Pennsylvanian), Missouri [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 29, no. 3, p. 1064B, 1968.

07217 **Neff, George.** Columbia Basin irrigation project, *in* Assoc. Eng. Geologists, 1968 Natl. Mtg., Seattle, Wash., Guidebook to field trips: [Sacramento, Calif.] Assoc. Eng. Geologists, p. 27-30, 1968.

Irrigation canals from Lake Roosevelt have recharged the ground water of the area in such a way that considerable geologic and engineering problems have resulted; their solutions are described. The irrigation features accomodate the geological structures of the region. The Coulee monocline is the primary structure and the various irrigation dams and canals are constructed to take advantage of this.-HRC

01456 **Neiheisel, James.** Techniques for use of organic and amorphous materials in source investigations of estuary muds [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 4, Southeastern Sec., p. 56, 1969.

01207 **Nelson, Arthur E.** Origin of some amphibolites in western North Carolina, *in* Geological Survey research 1969, Chap. B: U.S. Geol. Survey Prof. Paper 650-B, p. B1-B7, illus., tables, 1969.

Many bodies of amphibolite are interlayered with metasedimentary rocks in western North Carolina. Statistical data, field studies, and chemical affinities between these amphibolites and known ortho-amphibolites and basic igneous rocks strongly suggest that most of the amphibolites are ortho-amphibolites, rather than para-amphibolites. It is not known whether the rocks were originally intrusive bodies, basic tuffs, or lava flows, but probably many of the bodies represent thin-bedded pyroclastic deposits of basaltic composition and basalt flows that were interbedded with more felsic rocks. Others represent intrusive rocks of gabbroic origin, and some may represent dolerite dikes.-Author's abstract

01457 **Nelson, Bruce W.** Some biogeochemical variables in Rappahannock River bottom sediments [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 4, Southeastern Sec., p. 56-57, 1969.

07321 **Nelson, H. W.** Petrography of sandstone interbeds in the Upper Cretaceous-Paleocene of Gulf Spring Point: Bull. Canadian Petroleum Geology, v. 16, no. 4, p. 425-430, illus., table, 1968.

For further light on problems in the deformation of the southern Canadian Rockies, a petrographic analysis was made on selected samples from the Gulf Spring Point well in the Foothills region, to determine if any significant differences exist between sediments from the Upper Cretaceous and the Paleocene, which might reflect progressive advance of the source as well as repeated reworking during successive cycles. The intercalated sandstones show nothing to support an hypothesis of migrating foredeeps (Bally et al, 1966); rather, they suggest continuous sediment supply from essentially the same source. Relatively small and gradational changes in composition observed are caused by changes in proportion of rock constituents, not type. This shift is believed to result from progressively deeper erosion in the area of provenance.-GDC

07320 **Nelson, Samuel J.; Johnson, Ronald D.** Kaskattama No. 1 well, central Hudson Bay Lowland, Manitoba, Canada: Bull. Canadian Petroleum Geology, v. 16, no. 4, p. 431-443, illus., table, 1968.

This well, on the west shore of Hudson Bay, has penetrated a relatively thick (2913 ft) Phanerozoic section, including Devonian strata hitherto postulated as present in Hudson Bay Basin. Three broad units exist, called Lower Carbonate, Middle Clastic, and Upper Carbonate. The first is dominantly limestone and dolomite 2490 feet thick, resting on Precambrian crystallines. Fauna indicate that it contains temporal equivalents of the Late Ordovician Bad Cache Rapids and Churchill River groups, Early Silurian Port Nelson, and Middle Silurian Severn River, Ekwan River, and Attawapiskat formations. The middle unit, 653 feet thick and mainly red siltstone, is unfossiliferous but tentatively equated with Late? Silurian Kenogami River Formation. The upper unit is 400 feet of limestone correlated with Middle Devonian Abitibi River Formation.-*from* Authors' abstract

07136 **Neuman, Robert B.** Paleogeographic implications of Ordovician shelly fossils in the Magog belt of the northern Appalachian region, Chap. 3 *in* Studies of Appalachian geology, northern and marine (Zen, E-an, and others, editors): New York and London, Interscience Publishers, p. 35-48, illus., table, 1968.

Pre-Silurian rocks form a minor part of the exposed bedrock of the Magog belt, and only a small part of these are Ordovician; the rest are Precambrian or Cambrian. The Ordovician shelly fossil genera are European types. The rocks of Arenig to Llandeilo include shelly deposits in volcanic ejecta, which record the presence of volcanic islands from north-central Maine to northern Newfoundland. Rocks with lower Caradoc fossils are absent in the area; middle Caradoc rocks are dark pelites containing graptolites and are widespread in the area; and late Caradoc rocks contain abundant volcanic constituents. A variety of rocks with Ashgill fossils ranging from fine-grained calcareous siltstone to boulder conglomerate indicate a complex paleogeog-

raphy for the Late Ordovician. Several brachiopods are illustrated in plates and described.-JWC

**Newton, J. G.** *See* Turner, J. D. 07141

07269 **Newton, J. G.; Powell, W. J.; Golden, H. G.; Avrett, J. R.** Water resources, *in* Mineral and water resources of Barbour County, Alabama: Alabama Geol. Survey Inf. Ser. 37, p. 19-40, illus., tables, 1968.

All the geologic formations that crop out in Barbour County (Upper Cretaceous to Recent) contain ground water; its availability varies with formation structure and permeability. The geologic units and water-bearing characteristics are tabulated. Evaluation of availability is based on records of 193 wells and springs scattered over the county; data collected are listed in a table; chemical analyses of water are tabulated also. Hardness of water and objectionable iron content are widespread problems; that from the Clayton Formation is moderately hard to hard, and from the Nanafalia Formation and upper member of the Providence Sand commonly has iron in excess of 0.3 ppm. The chloride content is generally low, but may be high in aquifers south of depth contours 1,700 and 1,900.-GDC

01458 **Newton, John G.** Detailed bathymetry of the Hatteras submarine canyon system [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 4, Southeastern Sec., p. 57, 1969.

01071 **Newton, John G.; Pilkey, Orrin H.** Topography of the continental margin off the Carolinas: Southeastern Geology, v. 10, no. 2, p. 87-92, illus., 1969.

A topographic chart of the continental margin off the Carolinas has been prepared with a contour interval of 100 m. The data are also presented in the form of a block diagram. The sounding data were acquired by Duke University's R/V EASTWARD during cruises between October 1964 and August 1968. The major features of the continental margin in this area include a well developed continental slope-continental rise system and the northern tip of the Blake Plateau. The Hatteras Outer Ridge is found at the base of the rise. Crossing the slope rise and ending at the Hatteras Abyssal Plain is the Hatteras canyon system which is dendritic in form with three main tributaries.-Authors' abstract

**Newton, Robert C.** *See* Goldsmith, Julian R. 01261

01340 **Newton, Robert C.** Some high-pressure hydrothermal experiments on severely ground kyanite and sillimanite: Am. Jour. Sci., v. 267, no. 3, p. 278-284, illus., table, 1969.

Prolonged severe fine-grinding of an initially lightly-ground kyanite-sillimanite mixture greatly decreased its hydrothermal reactivity. Pressures required for kyanite growth relative to sillimanite at 750°C runs of a few days duration were substantially raised for the severely ground starting mix over the pressures needed to produce kyanite at the expense of sillimanite in the lightly ground mix. This effect is due to the preferential degradation of kyanite in grinding. Sillimanite nucleated in runs on degraded kyanite at 750°C as much as 2 kb above the stability limit of sillimanite determined from runs on the lightly ground mix. The faster degradation rate of kyanite may be sufficient to explain the relatively high pressure location of the kyanite-silimanite boundary deduced by Althaus (1967) in experiments on severely ground minerals.-Author's abstract

07329 **Nichols, Lee.** Field techniques for the economic and geotechnical evaluation of mining property for opencast mine design, Knob Lake, Quebec: Quart. Jour. Eng. Geology, v. 1, no. 3, p. 169-180, illus., table, 1968.

Severe ground-water problems at Knob Lake are a result of high water-table, active recharge rates and high permeability of the geological formations, with enhanced instability of artificial slopes. For investigating these factors for optimum mine-design criteria, an efficient geotechnical program combines with the standard economic

property evaluation: hydrological focus on water-balance studies for selected basins; water-table and pore-pressure measurements and flow nets for both ground-water basins and local ore zones; a geochemical program, in its initial stages using trace elements as natural tags to define ground-water flow and to proportion well-water discharges; and soil mechanics studies of shear strength, discontinuities and slip geometry. Applications in the Fleming basin and cases of slope features at Ruth Lake mine are presented.-GDC

01459 **Nichols, Maynard M.** Problems of estuarine sedimentation and transport [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 4, Southeastern Sec., p. 58, 1969.

01355 **Nicholson, Alex.; Wood, Patricia W.** Bibliography and index of Oklahoma geology, 1968: Oklahoma Geology Notes, v. 29, no. 2, p. 27-54, 1969.

01297 **Nickelsen, Richard P.; Hough, Van Ness D.** Jointing in south-central New York-Reply [to discussion of "Jointing in the Appalachian Plateau of Pennsylvania", 1967, by J. M. Parker, 1969]: Geol. Soc. America Bull., v. 80, no. 5, p. 923-925, 1969.

Nickelsen and Hough are not convinced that the acutely intersecting planar, master joints of Parker (1942; 1969) are members of one double set, but are convinced that such joint sets represent overprinting of two systematic sets originating at slightly different times. Reasons for this belief are given. Because Nickelsen and Hough believe that Set I joints in New York are two intersecting sets and because rose diagrams for large areas tend to blur correlations and create spurious data, the gradually progressive change in direction of major joints from east to west across the New York area proposed by Parker is not considered as proven.-VSN

07167 **Nitecki, Matthew H.** On the nature of the holotype of *Nipterella paradoxica* (Billings): Fieldiana-Geology, v. 16, no. 11, p. 289-295, illus., 1968.

The holotype of *Nipterella paradoxica* (Billings), based on *Calathium paradoxicum* Billings, 1865, is not a sponge but a cherty concretion. The name *Nipterella paradoxica* is thus a *nomen nudum* and should be rejected.-Author's abstract

**Noble, Donald C.** *See* Armstrong, Richard L. 01250

01198 **Norris, Stanley E.; Fidler, Richard E.** Correlation of carbonate rock units in northwest Ohio by natural gamma logging, *in* Geological Survey research 1969, Chap. B: U.S. Geol. Survey Prof. Paper 650-B, p. B158-B161, illus., 1969.

Natural gamma logs are a basis for determining the contact between the principal carbonate rock units in northwest Ohio, those of the Niagara and Cayuga Groups. Logs of the upper part of the Niagara Group, a dolomite of high purity, show a relatively low intensity of radiation and are almost featureless, in marked contrast to logs of the slightly less pure dolomite of the overlying Cayuga rocks. A characteristic change in radioactivity at or near the contact is identifiable on most logs in the study area. Data from 26 wells, supplemented by that obtained from quarry exposures, have been used to construct a structure contour map which conforms closely to the known regional structure. This map will be a significant aid in the interpretation of the hydrogeologic system in northwest Ohio.-Authors' abstract

**Norton, Stephen A.** *See* Hatch, Norman L., Jr. 07131

**Norton, Stephen A.** *See* Thompson, James B., Jr. 07251

01460 **Novak, G. A.; Gibbs, G. V.** The crystal structure of andradite [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 4, Southeastern Sec., p. 58, 1969.

01383 **Nuttli, Otto W.** Travel times and amplitudes of S-waves from nuclear explosions in Nevada: Seismol. Soc. America Bull., v. 59, no. 1, p. 385-398, illus., tables, 1969.

Underground Nevada explosions Half-Break and Greeley created large amplitude and long-period body S-waves detectable at teleseismic distances. Observations of

traveltimes of these waves provide a surface focus traveltime curve similar to that calculated from the upper mantle velocity model of Ibrahim and Nuttli (1967), with low-velocity channel at 150-200 km and regions of rapidly increasing velocity at 400 and 750 km. S-wave amplitudes suggest a discontinuous increase in velocity at 400 km; at 750 km velocity is continuous but velocity gradient discontinuous. Body-wave magnitudes calculated from S-amplitudes are $5.3 \pm 0.2$ for Greeley and $4.9 \pm 0.2$ for Half-Break. The regional stress field is the same for Half-Break, Greeley, and Bilby sites, and the direction of cracking as well as strain energy release in the elastic zone outside the cavity is determined by the regional stress field.-*from* Author's abstract

07198 **Nye, Thomas Spencer.** The relationship of structure and alteration to some ore bodies in the Bisbee (Warren) district, Cochise County, Arizona [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 29, no. 4, p. 1408B, 1968.

**Obradovich, J. D.** *See* Rohrer, W. L. 01177

01416 **O'Connor, Michael P.; Riggs, Stanley R.; Winston, Don; Breuninger, Ray H.** Nearshore sediments and sedimentary processes in the Clearwater-Treasure Island area, Pinellas County, Florida [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 4, Southeastern Sec., p. 58-59, 1969.

**O'Connor, Michael P.** *See* Riggs, Stanley R. 01419

01441 **Odum, Howard T.; Copeland, B. J.** A classification of the estuarine ecological systems of the United States on energy source and stress principles [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 4, Southeastern Sec., p. 59, 1969.

**Oetking, Philip.** *See* Feray, Dan E. 07144

01280 **O'Hara, M. J.; Biggar, G. M.** Diopside + spinel equilibria, anorthite and forsterite reaction relationships in silica-poor liquids in the system $CaO$-$MgO$-$Al_2O_3$-$SiO_2$ at atmospheric pressure and their bearing on the genesis of melilitites and nephelinites: Am. Jour. Sci., v. 267-A (Schairer Volume), p. 364-390, illus., tables, 1969.

Three univariate (isobaric invariant) equilibria have been located between 1233° and 1230°C: anorthite + forsterite + diopside + liquid, forsterite + melilite + diopside + spine + liquid, and anorthite + melilite + diopside + spinel + liquid. An invariant equilibrium anorthite + forsterite + melilite + diopside + spinel + liquid may occur at a pressure below atmospheric and a temperature above 1230°C. Anorthite and forsterite are in reaction relation with a silica-poor liquid in the first of the above equilibria, forsterite in the second, while the third is an eutectic. The reaction relation between calcic plagioclase and liquid may persist into more complex systems, thereby permitting derivation of melilite-nephelinites by low-pressure fractional crystallization of alkali-olivine basalts.-*from* Authors' abstract

01190 **Oldale, Robert N.** Seismic investigations on Cape Cod, Martha's Vineyard, and Nantucket, Massachusetts, and a topographic map of the basement surface from Cape Cod Bay to the islands, *in* Geological Survey research 1969, Chap. B: U.S. Geol. Survey Prof. Paper 650-B, p. B122-B127, illus., 1969.

Seismic data from coastal southeastern Massachusetts show one or two layers of unconsolidated sediments of Holocene to Late Cretaceous age over a basement of crystalline and sedimentary rock of pre-Mesozoic age. The basement surface slopes gently seaward and is cut by deep valleys.-Author's abstract

07227 **Olmsted, Terry.** Lower Baker River landslide, *in* Assoc. Eng. Geologists, 1968 Natl. Mtg., Seattle, Wash., Guidebook to field trips: [Sacramento, Calif.] Assoc. Eng. Geologists, p. 98-101, illus., 1968.

The slope on which the Lower Baker River slide developed is composed primarily of glacially overconsolidated, highly fractured and slickensided silt and clay containing discontinuous sand pockets, resting upon argillite, phyllite, and some limestone. Early movement was detected by small cracks and scarps; it reached about 17 inches

per day and then finally moved about 100 feet vertically in something less than six hours. Over 150,000 cubic yards of slide material have been removed so far.-HRC

07199 **Olson, Harry J.** The geology and tectonics of the Idaho porphyry belt from the Boise Basin to the Casto quadrangle [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 29, no. 4, p. 1409B, 1968.

**Onuma, Kosuke.** *See* Yagi, Kenzo. 01281

**Oostdam, B. L.** *See* Jordan, R. R. 01487

07245 **Osberg, P. H.; Moench, R. H.; Warner, Jeffrey.** Stratigraphy of the Merrimack synclinorium in west-central Maine, Chap. 18 *in* Studies of Appalachian geology, northern and marine (Zen, E-an, and others, editors): New York and London, Interscience Publishers, p. 241-253, illus., tables, 1968.

The Merrimack synclinorium is the dominant tectonic feature of west-central Maine. The trough of the synclinorium is defined by a thick mass of predominantly pelitic rocks of probable Devonian age. The limbs on either side are comprised of either Silurian and Silurian(?) or Devonian-the Rangeley, Perry Mountain, Smalls Falls, and Madrid Formations on the northwest, and the Mayflower Hill, Waterville, and Vassalboro Formations on the southeast. The Middle Ordovician Dixville Formation is exposed farther northwest as well as a sequence of younger Ordovician rocks that grade upward and southeastward into the Rangeley Formation. The Taconic orogeny was expressed in the Rangeley area by a great influx of coarse clastic sediments, the Rangeley Conglomerate, and the higher conglomerates of the Rangeley Formation with no interruption in deposition.-JWC

07146 **Osborne, F. Fitz.** Guettard's map of Canada and Louisiana-A geologic first, *in* Editions speciales du centenaire, 1868-1968-Sciences de la terre: Naturaliste Canadien, v. 95, no. 6, p. 1189-1193, illus., 1968.

Jean Étienne Guettard, a Frenchman who travelled extensively in the 18th century, made a map of eastern North America published in 1756. He never visited the New World but made notes on the presence of geological phenomena on the map based upon published accounts and from contacts with persons who were in North America. The map shows the locations of mineral resources as well as types of rocks and fossils; its poor quality as well as its misinformation have caused its rejection as the first geological map of the New World, but he still deserves some credit.-HRC

01336 **Ostrom, John H.** A new theropod dinosaur from the Lower Cretaceous of Montana: Postilla, no. 128, 17 p., illus., 1969.

*Deinonychus antirrhopus*, a new genus and species of theropod dinosaur is described from the Cloverly Formation (Lower Cretaceous) of southern Montana. The species is characterized by a highly specialized pes bearing a very large, trenchant claw on digit II, a highly raptorial manus with a very mobile carpus, and a specialized caudal series with extremely long prezygapophyseal and chevron rods. The new species is closely related to *Dromaeosaurus albertensis*, which features similar specialization of the second pedal digit, and is referred to the family Dromaeosauridae (=Dromaeosaurinae Matthew and Brown, 1922). Other species with comparable pes structure that may be referred to this family are *Stenonychosaurus inequalis*, *Velociraptor mongoliensis* and *Saurornithoides mongoliensis*.-Author's abstract

07303 **Oversby, V. M.; Gast, P. W.** Oceanic basalt leads and the age of the Earth [discussion of paper by T. J. Ulrych, 1967]: Science, v. 162, no. 3856, p. 925-927, illus., 1968.

Ulrych (ibid., v. 158, no. 3798, p. 252-256, 1967) recently derived an age for the Earth independent of the age of samples used in calculations. In the absence of any criterion for distinguishing whether or not fractionation of mantle systems that make up the source of a set of basalt samples has taken place, it is impossible to select any upper intercept with the Concordia curve as $T_o$, the age of the Earth. The existence

of different upper intercepts indicates that fractionation of mantle systems has taken place. A number of systems were "three-stage systems," the third stage beginning with a change in U-238:Pb-204 at the time of formation of basaltic rocks. Several lines of evidence support the view that observed values are not representative of their source. The Concordia method is much inferior to the lead evolution diagram as a means of analyzing recent basalts.-DBV

01069 **Overstreet, William C.; Warr, Jesse J., Jr.** Thorium and uranium in detrital monazite from the Georgia Piedmont: Southeastern Geology, v. 10, no. 2, p. 63-76, illus., tables, 1969.

Fifteen samples of detrital monazite from the Georgia Piedmont contain 3.3 to 6.1 percent of $ThO_2$ and 0.13 to 0.67 percent of $U_3O_8$, bearing out a previously established relationship of increased thorium content in monazite as the metamorphic grade of the host rock increases. Relations and geologic controls of the amount of uranium in monazite remain unclear; possibly low uranium/thorium ratios associated with high percentages of thorium indicate a granitic source, and high ratios associated with low percentages of thorium indicate paraschist or paragneiss as the source. Further work on this problem is needed.-Authors' abstract

01363 **Oxley, Marvin L.; Minihan, E. D.** Alabama exploration under way, Pt. 1: Oil and Gas Jour., v. 67, no. 4, p. 207, 209-212, illus., 1969; Pt. 2, ibid., no. 5, p. 125-126, illus., 1969.

This report presents an interpretation of the stratigraphic relationships of Jurassic sediments in Alabama and northern Florida. The authors conclude that potential petroleum reservoirs may be found in blanket sands, dolomitic porosities, carbonate mounds, clastic shoals, distributary sands, and oolitic limestone. Basic data sources were electric and sample logs of 70 wells which penetrated Jurassic sediments in the study area.-HHA

07255 **Page, Lincoln R.** Devonian plutonic rocks in New England, Chap. 28 *in* Studies of Appalachian geology, northern and marine (Zen, E-an, and others, editors): New York and London, Interscience Publishers, p. 371-383, illus., table, 1968.

Three Devonian plutonic series are recognized in New England. The Oliverian Plutonic Series was intruded into unmetamorphosed Ordovician or Cambrian rocks. Structural and textural features suggest that these magmas were forcefully injected, differentiated in place, and were subsequently metamorphosed. The New Hampshire Plutonic Series was emplaced and crystallized under Acadian orogenic stresses. These magmas differentiated at depth and were injected as separate bodies which crystallized with relatively uniform composition. Other plutonic rocks that cut Lower Devonian and are overlain unconformably by Mississippian rocks but do not fit the criteria for the first two series are referred to the Late Devonian Plutonic Series; these form a complete sequence of ultramafic rocks, gabbros, norites, granodiorites, monzonites, quartz monzonites, and granites.-JWC

01345 **Palmer, H. C.** The paleomagnetism of the Croker Island complex, Ontario, Canada: Canadian Jour. Earth Sci., v. 6, no. 2, p. 213-218, illus., table, 1969.

Meaningful paleomagnetic results were obtained from 23 of 30 oriented samples from the Croker Island complex, North Channel of Lake Huron, Canada. The age of the complex is estimated to be 1475 ± 50 m.y. from an Rb-Sr isochron. The paleomagnetic pole calculated from the directions of remanent magnetism after partial ac demagnetization is 143° W., 5 1/2° N. This result, when compared with other paleomagnetic results from North America, indicates little or no polar wandering in the time interval 1.48 b.y. to 1.1 b.y. However, a significant shift in the pole position is indicated during the time interval 1.7 to 1.48 b.y.-Author's abstract

**Palmer, R. A.** *See* McCormick, J. E. 01064

07325 **Pannella, Giorgio; MacClintock, Copeland; Thompson, Maxwell N.** Paleontological evidence of variations in length of synodic month since Late Cambrian: Science, v. 162, no. 3855, p. 792-796, illus., table, 1968.

The values of length of synodic month, obtained from tidally controlled periodical growth patterns in mollusks and stromatolites for several geologic periods, indicate that the deceleration rate of the Earth's rotation has not been constant. Two breaks in slope, in the Pennsylvanian and Cretaceous, may be related to changes in distribution of continents, oceans, and adjacent shallow seas.-Authors' abstract

**Park, J. K.** *See* Robertson, W. A. 01328

01442 **Park, Richard A.; Feldhausen, Peter H.** Quantitative biofacies analysis-Cape Hatteras, North Carolina [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 4, Southeastern Sec., p. 60, 1969.

01298 **Parker, John M., 3d.** Jointing in south-central New York-Discussion [of "Jointing in the Appalachian Plateau of Pennsylvania" by R. P. Nickelsen and V. D. Hough, 1967]: Geol. Soc. America Bull., v. 80, no. 5, p. 919-922, illus., 1969.

The study of jointing in Pennsylvania by Nickelsen and Hough (ibid., v. 78, p. 609-629, 1967) disagrees in two important aspects from Parker's findings (1942) in adjacent New York: first, the double nature of the joints designated "Set I", and second, the progressive swing in strike of joints across the area. On the basis of a brief field study in 1968 and a review of original field notes, Parker reiterates his original findings.-VSN

01417 **Parker, Robert H.; Scott, Jane V.; Berry, Ronald F.; Baker, James H.; Harrell, William W.** Comparisons of estuarine ecosystems [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 4, Southeastern Sec., p. 60-61, 1969.

07273 **Paul, R. H.** Formation water saturation in gas reservoirs-A comparison of log data derived from extracted oil base cores, *in* SPWLA Logging Symposium, 9th Ann., New Orleans, La., 1968, Trans: Houston, Tex., Soc. Prof. Well Log Analysts, p. II-113, illus., 1968.

In carbonate gas reservoirs, $R_t$ derived directly from laterolog type devices are valid, and subsequently water saturations are comparable to oil-base core data. In nonshaly gas sand reservoirs, with both mobile and nonmobile formation water, excellent correlations are obtained using standard induction E logs. Log-derived SW using Laterolog devices in sand reservoirs is less accurate because of lower resistivities and higher water saturations. Therefore, in the absence of SW data from oil-base cores, restored state or other pressure data, carefully derived log SW data expressed as porosity-saturation curves may be used reliably for reservoir volume calculations.-*from* Author's abstract

07138 **Pavlides, Louis; Boucot, A. J.; Skidmore, W. B.** Stratigraphic evidence for the Taconic orogeny in the northern Appalachians, Chap. 5 *in* Studies of Appalachian geology, northern and marine (Zen, E-an, and others, editors): New York and London, Interscience Publishers, p. 61-82, illus., table, 1968.

Stratigraphic evidence for the Taconic orogeny is reviewed comprehensively from the literature. Three pulses of diastrophism are recorded; they took place between Trenton and pre-Llandovery times. There are two belts of angular unconformity, an eastern and a western, flanked by parallel belts of disconformity, which in turn in some places bound areas of conformity between the Ordovician and Silurian.-JWC

01232 **Pearce, G. W.; Freda, G. N.** Magnetization of the Perry Formation of New Brunswick, and the rotation of Newfoundland-Discussion [of 1965 paper by W. A. Robertson, J. L. Roy, and J. K. Park]: Canadian Jour. Earth Sci., v. 6, no. 2, p. 353-355, table, 1969.

Statistical analysis of the data from Perry Sandstone collected at Blacks Harbor, New Brunswick, indicates that the resolution of two components of magnetization previously reported [ibid., v. 5, p. 1175-1181, 1965] is not justifiable.-Authors' abstract

01219 **Pearce, T. H.** Some comments on the differentiation of the Dundonald sill, Ontario: Canadian Jour. Earth Sci., v. 6, no. 1, p. 75-80, illus., table, 1969.

A new technique for analyzing natural data is used on chemical data from the Dundonald sill. It is shown thereby that, with certain exceptions, the conclusions reached by Naldrett and Mason (1968) regarding the differentiation of the sill could have been expressed with greater certainty. The natural chemical data may be used as an independent check on rival hypothetical differentiation processes. The use of conventional graphical techniques has resulted in critical information remaining unused in tables of chemical analyses.-Author's abstract

**Penzien, Joseph.** *See* Dibaj, Mostafa. 01374

**Peterman, Z. E.** *See* Turek, A. 07236

07289 **Petersen, Ole V.** The mineralogy of naujakasite, *with chemical analyses* by I. Sörensen: Grönlands Geol. Undersögelse Bull. 75, p. 1-17, illus., tables, reprinted 1968; originally published 1967.

This paper was published originally in Medd. Grönland, v. 181, no. 6, 1967. *See* Abstracts of North America Geology for August 1968.-MCM

01367 **Peterson, Fred.** Four new members of the Upper Cretaceous Straight Cliffs Formation in the southeastern Kaiparowits region, Kane County: U.S. Geol. Survey Bull. 1274-J, p. J1-J28, illus., 1969.

The Straight Cliffs Formation is newly divided here, in ascending order: the Tibbett Canyon, Smoky Hollow, John Henry, and Drip Tank Members. Bottom and top members are cliff-forming sandstones, the middle two ledge- and slope-forming units of interbedded sandstone, mudstone, and coal. The John Henry Member contains the major coal resources of this region. Depositional environments on this western side of the Late Cretaceous seaway were: beach and shallow-water marine for the Tibbetts Canyon; fluvial, floodplain, lagoonal, and palludal for the Smoky Hollow; erosional unconformity; similar marine and nonmarine for the John Henry; fluvial for the Drip Tank. Age indicated is middle to late Turonian for first two members, correlated with middle Carlile Shale, and middle Coniacian to early Campanian for last two, correlated with middle to upper Niobrara Formation.-GDC

07200 **Peterson, Richard Charles.** A structural study of the east end of the Catalina Foreange, Pima County, Arizona [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 29, no. 4, p. 1409B, 1968.

**Petkewich, Richard M.** *See* Hoffman, Dale S. 01244

01348 **Pfirman, Richard S.** Stratigraphy and history of the Toroweap Formation (Permian) between Grindstone Canyon and Sycamore Canyon, Arizona: Plateau, v. 41, no. 3, p. 141-152, illus., table, 1969.

The Toroweap Formation between Grindstone and Sycamore Canyons was deposited on a shelf adjacent to the easternmost advance of the Toroweap sea; it is an area of transition between normal marine deposition to the west, and predominately subaerial deposition to the southeast. In most of the area, the Toroweap may be divided into three members, in ascending order: Gamma, deposited in a low energy beach-forming environment during transgression of the sea; Beta, formed by chemical precipitation of calcareous ooze from saline, restricted waters of the extended sea; and Alpha, deposited in shallow, restricted basins alternately submergent and emergent during overall regression of the sea.-*from* Author's abstract

01375 **Phillips, H. Boyd; McDonald, Harris R.** Analog of ground water in east-central New Mexico: Am. Soc. Civil Engineers Proc., v. 95, paper 6435, Jour. Irrigation and Drainage Div., no. IR 1, p. 27-42, illus., 1969.

A study, utilizing an electric resistor-capacitor analog model, has been made to determine the adequacy of the ground-water supply for the approximate 60,000 acres now irrigated in Portales Valley, New Mexico. Results indicated that over 60 percent of the irrigated area will be without sufficient water by the year 2010 unless an additional supply is found. A proposed plan to import water from a well field out-

side the project area was investigated. The aquifer underlying the project area would be utilized as a distribution system. Although some small areas would become deficient, the supply of water from the well field would be sufficient to sustain irrigation in nearly all the area now under irrigation until at least the year 2010.-Authors' abstract

01432 **Phillips, M. W.; Ribbe, P. H.** The crystal structure of oligoclase ($An_{15}$)-Further evidence for a domain model of intermediate plagioclase [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 4, Southeastern Sec., p. 61-62, 1969.

**Phillips, R. Lawrence.** *See* Clifton, H. Edward. 01308

01433 **Phyfer, Daniel W.; Carpenter, John R.** Geochemistry and petrology of the Day Book (NC) dunite [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 4, Southeastern Sec., p. 62-63, 1969.

**Pierce, J. W.** *See* Roberts, W. P. 01421

01434 **Pierce, J. W.; Colquhoun, D. J.** Coastal changes in North Carolina caused by Hurricane Gladys [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 4, Southeastern Sec., p. 63, 1969.

01435 **Pierce, R. W.; Langenheim, R. L., Jr.** Ultrastructure of some selected Mississippian conodonts [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 4, Southeastern Sec., p. 63, 1969.

**Pilkey, O. H.** *See* Macintyre, I. G. 01462

**Pilkey, Orrin H.** *See* Newton, John G. 01071

01436 **Pilkey, Orrin H.; Milliman, John.** Sedimentation on the Atlantic shelf off the southern United States [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 4, Southeastern Sec., p. 63-64, 1969.

07214 **Pilz, Hugo A.** Stemilt Creek basin landslide near Wenatchee, *in* Assoc. Eng. Geologists, 1968 Natl. Mtg., Seattle, Wash., Guidebook to field trips: [Sacramento, Calif.] Assoc. Eng. Geologists, p. 11-13, 1968.

This slide is important because of its unusually large areal extent (25 sq mi) and its proximity to the city of Wenatchee. Over 4,000 feet of Tertiary sedimentary rocks are overlain by several hundred feet of Columbia River basalt; all are involved in the slide. Boulders across the canyon indicate its original extent. Pleistocene terraces, developed on the slide material and also rotated by it, suggest a Pleistocene age for the slide. Current activity is shown by roadway distress, new springs appearing and old ones drying up, and varying static elevations in perched water tables. Almost every landform feature commonly associated with landslide is present.-HRC

**Pirie, Gordon R.** *See* Swift, Donald J. 01549

**Pirson, S. J.** *See* Rodriguez, A. R. 07272

**Pomeroy, Larry R.** *See* Reimold, Robert J. 01429

01405 **Post, Benjamin.** The intensities of multiple diffraction effects [abs.], *in* Accurate determination of X-ray intensities and structure factors, Internat. Mtg., Cambridge, England, 1968: Acta Cryst., v. A25, pt. 1, p. 94; discussion, p. 95, 1969.

01437 **Powell, C. McA.** Structures in tectonically dewatered slates [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 4, Southeastern Sec., p. 64, 1969.

**Powell, W. J.** *See* Newton, J. G. 07269

01438 **Pratt, Richard M.** A comparison of coastal marine terraces in Virginia and Alaska [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 4, Southeastern Sec., p. 65, 1969.

01439 **Price, Van.** Trace element distribution in plutonic rocks of the southeastern Piedmont [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 4, Southeastern Sec., p. 65, 1969.

**Proctor, J. F.** *See* Marine, I. W. 01443

01196 **Purtymun, William D.; Cooper, James B.** Development of ground-water supplies on the Pajarito Plateau, Los Alamos County, New Mexico, *in* Geological Survey research 1969, Chap. B: U.S. Geol. Survey Prof. Paper 650-B, p. B149-B153, illus., tables, 1969.

The Pajarito Mesa well field, completed in 1966 on the Pajarito Plateau, contributed 37 percent of the total water supply to Los Alamos in 1967. Two wells in the field are capable of yields of 1,400 gallons per minute each. This yield is about three times that of any of the other 13 supply wells in the water-supply system. The high yield of the two wells is attributed to the occurrence of coarse volcanic debris and arkosic sediment in the Puye and Tesuque Formations of the Santa Fe Group that make up the main aquifer beneath the Pajarito Plateau.-Authors' abstract

**Quarles, K. G.** *See* McCormick, J. E. 01064

**Quesada, A.** *See* Dennen, W. H. 01521

07247 **Quinn, Alonzo W.; Moore, George E., Jr.** Sedimentation, tectonism, and plutonism of the Narragansett basin region, Chap. 20 *in* Studies of Appalachian geology, northern and marine (Zen, E-an, and others, editors): New York and London, Interscience Publishers, p. 269-279, illus., table, 1968.

The main groups of rocks of the Narragansett basin region are: (1) older metamorphic rocks, including the Blackstone Series, which consists of mica schist, quartzite, greenstone, and marble; (2) older plutonic rocks ranging from quartz diorite to granite, which may belong to one or to several plutonic episodes; (3) plutonic and volcanic rocks of intermediate age that were emplaced after exposure and erosion of the older rocks; (4) Pennsylvanian rocks, mostly clastic sedimentary rocks, of the Narragansett basin; and (5) young granitic rocks that are intrusive into the Pennsylvanian rocks.-JWC

07147 **Rabie, Farida Hamed.** Mineral weathering and distribution in a series of salt-affected soils [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 29, no. 3, p. 842B, 1968.

**Radcliffe, D. R.** *See* Simmons, W. B., Jr. 01544

**Ragland, P. C.** *See* Dietrich, R. V. 01409

01440 **Ragland, Paul C.; Butler, J. Robert.** Differentiation trends in the intrusive rocks of the Carolina Piedmont [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 4, Southeastern Sec., p. 66, 1969.

**Ragland, Paul C.** *See* Carpenter, John R. 01516

01256 **Rahman, S.; MacKenzie, W. S.** The crystallization of ternary feldspars-A study from natural rocks: Am. Jour. Sci., v. 267-A (Schairer Volume), p. 391-406, illus., tables, 1969.

Composition of coexisting alkali and plagioclase feldspar phenocrysts and groundmass feldspars in trachytes from the Island of Ischia have been used to study the crystallization behavior of feldspars in the ternary system. The plagioclase feldspars invariably show textures that can be interpreted as due to resorption. Using Grieg's (unpub.) graphical construction it is shown that the plagioclase feldspars in this suite

of rocks would be expected to be resorbed when their composition is about $An_{40-35}$ under conditions of perfect equilibrium cooling. Partial fractionation will tend to delay resorption of a later stage of crystallization.-Authors' abstract

07317 **Ranalli, G.; Scheidegger, A. E.** Topological significance of stream labeling methods: Internat. Assoc. Sci. Hydrology Bull., v. 13, no. 4, p. 77-85, illus., 1968.

Several stream ordering and labeling methods have been proposed in order to describe the geometry of river networks; namely, Horton's, Strahler's, Milton-Ollier's, Scheidegger's ordering techniques, and the STORET location coding system. The amount of information on the topological structure of the net that each of these methods can yield is analyzed. Horton's and Strahler's ordering methods give only numerical information on the distribution of channels among different classes (orders); Milton-Ollier's and Scheidegger's methods give more information, from the topological point of view, as the former assigns a unique label to each stream segment in a network, and the latter takes into account all junctions; the STORET system labels interconnections between channels, but does not use the concept of order and is therefore more suitable for other purposes.-*from* Authors' abstract

01070 **Randazzo, Anthony F.** X-ray analyses of rocks of the Carolina Slate Belt, Union County, North Carolina: Southeastern Geology, v. 10, no. 2, p. 77-86, illus., tables, 1969.

Fifty-seven samples were collected from a variety of low-rank metamorphic rocks in Union County, N. C. Modal analyses of these samples were performed by means of X-ray diffraction techniques. Semi-quantitative results were obtained. These data, however, provide at least some measure of the mineral percentages in the extremely fine-grained meta-volcanic and epiclastic rocks. Composition of the argillites and sandstones are very similar despite stratigraphic position. These data also show a relatively high proportion of quartz in many samples suggesting an episode of silicification which probably accompanied metamorphism.-Author's abstract

01302 **Randolph, J. R.; Baker, N. M.; Deike, R. G.** (compilers). Bibliography of hydrology of the United States and Canada, 1964: U.S. Geol. Survey Water-Supply Paper 1864, 232 p., 1969.

01418 **Rankin, Douglas W.** The Fries fault-A major thrust in the Blue Ridge Province of southwestern Virginia [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 4, Southeastern Sec., p. 66-67, 1969.

07254 **Rankin, Douglas W.** Volcanism related to tectonism in the Piscataquis volcanic belt, an island arc of Early Devonian age in north-central Maine, Chap. 27 *in* Studies of Appalachian geology, northern and marine (Zen, E-an, and others, editors): New York and London, Interscience Publishers, p. 355-369, illus., table, 1968.

A belt of nearly contemporaneous and lithologically similar volcanic and shallow intrusive rocks extends about 100 miles across north-central Maine from Heald Mountain on the southwest to Snowshoe Mountain on the northeast. The igneous rocks of this belt are predominantly felsic and are mostly extrusive rhyolites. These volcanic rocks occur in a geosynclinal environment and are Early Devonian in age. The name Piscataquis volcanic belt is proposed in this paper for these volcanics. The belt is considered to be part of an island-arc system, which parallels a series of en echelon synclinoria produced during the Acadian orogeny.-JWC

07264 **Rascoe, Bailey, Jr.** Permian System in western Mid-Continent, *in* Guidebook issue, southeastern Colorado: Mtn. Geologist, v. 5, no. 3, p. 127-138, illus., 1968.

The Wolfcamp, Leonard, and Guadalupe Series of the Permian System in the west Texas region are recognized in the Permian System of the western Mid-Continent [Kansas, Oklahoma, eastern Colorado, northeastern New Mexico, and Texas panhandle]. In the latter region intra-Wolfcamp and intra-Leonard tectonic events and subsequent changes in depositional patterns provide the basis for establishment of upper and lower stages in the Wolfcamp and Leonard Series. The evolution from

dominantly marine beds (Wolfcamp) to cyclic marginal marine to continental redbeds and evaporites (Leonard and Guadalupe) reflects the regression and withdrawal of marine waters from the western Mid-Continent during Permian time.-Author's abstract

**Rasnick, F. D.** *See* McCormick, J. E. 01064

**Rathbun, R. E.** *See* Grigg, Neil S. 01181

**Rebello, Dennis P.** *See* Banks, Philip O. 01296

01427 **Reeburgh, W. S.** Some processes affecting gas distribution in estuarine sediments [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 4, Southeastern Sec., p. 67, 1969.

01428 **Reesman, Arthur L.** Systems $Al_2O_3$-$SiO_2$-$H_2O$ and $K_2O$-$Al_2O_3$-$SiO_2$-$H_2O$ at STP [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 4, Southeastern Sec., p. 67, 1969.

**Rehkemper, L. J.** *See* Lankford, R. R. 01465

01300 **Reichert, William H.** Bibliography and index of the geology and mineral resources of Washington, 1957-1962: Washington Div. Mines and Geology Bull. 59, 375 p., 1969.

This bibliography includes abstracts, reviews, discussions, criticisms, theses, and selected unpublished reports, as well as a number of articles unintentionally omitted from Bulletin 46 (1960, Reichert, 1937-56).-MCM

07201 **Reid, Alastair Milne, 2d.** Biostratigraphy of the Naco Formation (Pennsylvanian) in south-central Arizona [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 29, no. 4, p. 1410B, 1968.

01429 **Reimold, Robert J.; Pomeroy, Larry R.** The flux of phosphorus through an undisturbed salt-marsh ecosystem [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 4, Southeastern Sec., p. 67-68, 1969.

**Renfro, H. B.** *See* Feray, Dan E. 07144

**Requist, Norris N.** *See* Bolyard, Dudley W. 07267

**Reynolds, Robert C.** *See* Anderson, Duwayne M. 01299

**Ribbe, P. H.** *See* Stewart, D. B. 01272

01430 **Ribbe, P. H.; Gibbs, G. V.** Distortions of coordination polyhedra in topaz [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 4, Southeastern Sec., p. 68, table, 1969.

**Ribbe, P. H.** *See* Phillips, M. W. 01432

**Ribbe, P. H.** *See* Gibbs, G. V. 01493

**Ribbe, P. H.** *See* Brown, G. E. 01512

**Rich, Jean.** *See* Blanton, W. George. 01529

01431 **Richards, Horace G.; Abbott, R. Tucker; Skymer, Thomas.** Marine Pleistocene mollusks from Bermuda [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 4, Southeastern Sec., p. 69, 1969.

01338 **Richardson, S. W.; Gilbert, M. C.; Bell, P. M.** Experimental determination of kyanite-andalusite and andalusite-sillimanite equilibria; the aluminum silicate triple point: Am. Jour. Sci., v. 267, no. 3, p. 259-272, illus., tables, 1969.

The kyanite-andalusite and andalusite-sillimanite transitions have been experimentally bracketed by observation of reversals of the polymorphic transitions in mixtures of the appropriate pair or polymorphs. A hydrostatic-medium pressure apparatus was used, and only reactions which showed about 20 percent conversion or more were accepted as diagnostic. The triple point occurs within a polygon of experimental uncertainty around the coordinates 5.5 kb, 622°C. The equations that best express the univariant equilibrium boundaries, in terms of kb and degrees Celsius are: kyanite-andalusite, $P=0.0107T - 1.173$; andalusite-sillimanite, $P=-0.0243T+20.59$. From previous work may be added kyanite-sillimanite, $P=0.0243T - 9.63$.-*from* Authors' abstract

01221 **Riddell, John F.** A laboratory study of suspension-effect density currents: Canadian Jour. Earth Sci., v. 6, no. 2, p. 231-246, illus., tables, 1969.

A more effective, dropping method of release has been devised. A new linear proportionality equation is adopted for correctly correlating the variables acting in the system, and the significance of the densimetric Froude-Reynolds number for suspension-effect current studies is shown. The expected increase in both velocity and total extension with increasing concentration is verified also. Viscous scale effects have been examined by using two sizes of geometrically similar flumes and a short range congruency type of diagram. Suspension-effect currents are compared with the simpler solution-effect currents, and the greater influence of viscosity on the former is discussed. The suitability of using solution-current congruency diagrams for model/prototype studies is discussed.-*from* Author's abstract

**Riggs, Stanley R.** *See* O'Connor, Michael P. 01416

01419 **Riggs, Stanley R.; O'Connor, Michael P.; Winston, Don.** Estuarine sedimentation in the Roanoke Island area, Dare County, North Carolina [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 4, Southeastern Sec., p. 69, 1969.

01350 **Rinehart Oil News Company.** (Special Publications Department). Ira Rinehart's yearbook 1969-A statistical and graphical summary of wildcat discoveries, new pays, major extensions and significant failures in 20 states during 1968: Dallas, Tex., Rinehart Oil News Co., sections paged separately, illus., 1969.

In addition to a financial section, the review of exploration and development is grouped geographically into: Texas, southeastern New Mexico, midcontinent area, Arkansas-Louisiana, southeastern states, and Rocky Mountains.-MCM

**Riner, B. G.** *See* McCormick, J. E. 01064

01283 **Ritter, John R.** Measurement of water flow and suspended-sediment load, Bolinas Lagoon, Bolinas, California, *in* Geological Survey research 1969, Chap. B: U.S. Geol. Survey Prof. Paper 650-B, p. B189-B193, illus., 1969.

Measurement of water flow and sediment load at the lagoon inlet for a 10-hr tidal period in June 1967, revealed that 152 tons of suspended sediment was carried into the lagoon by floodtide, whereas only 36 tons was carried out by ebbtide. However, the largest ebbtide, which was not measured, probably carried the largest load of the day. Maximum measured water flow and maximum average velocity during floodtide were 5,810 cfs and 3.5 fps, respectively; during ebbtide, maximums were 3,720 cfs and 2.4 fps. Higher temperatures of water at the inlet possibly indicated lagoon water and ebbtide, and lower ones, ocean water and floodtide.-*from* Author's abstract

01318 **Roberson, C. E.; Hem, J. D.** Solubility of aluminum in the presence of hydroxide, fluoride, and sulfate: U.S. Geol. Survey Water-Supply Paper 1827-C, p. C1-C37, illus., tables, 1969.

The total concentration of aqueous dissolved species of aluminum that will be present in equilibrium with microcrystalline gibbsite at various levels of complexing ligand concentration are shown graphically. The graphs can be used to estimate aluminum solubility, at 25°C and 1 atm total pressure, where the pH of the solution, its ionic strength, and the total sulfate and fluoride concentrations are known. The stan-

dard free energy of formation of cryolite calculated from solubility experiments is -745.4 ± 1.0 kcal per mole at 25°C. Diagrams are included showing the solubility of cryolite in terms of aluminum, fluoride, and sodium concentrations. The stability fields of cryolite and microcrystalline gibbsite and their solubilities are also shown on pH-[F] diagrams.-Authors' abstract

01421 **Roberts, W. P.; Pierce, J. W.** Preliminary observations on the lower Patuxent River and upper estuary [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 4, Southeastern Sec., p. 69-70, 1969.

01227 **Robertson, J. A.; Frarey, M. J.; Card, K. D.** The Federal-Provincial Committee on Huronian stratigraphy-Progress report: Canadian Jour. Earth Sci., v. 6, no. 2, p. 335-336, table, 1969.

A Federal-Provincial Committee on Huronian Stratigraphy has been organized to review the present knowledge of the Huronian Supergroup, to apply a suitable stratigraphic nomenclature, and to describe type and reference sections for formations and groups. A nomenclature has been recommended and is stated in this note. Type and reference sections will be measured during the next two years.-Authors' abstract

07324 **Robertson, James A.** Zircon correlation with special reference to the granitic rocks of the North Shore of Lake Huron: Ontario Dept. Mines Misc. Paper 21, 18 p., illus., tables, 1968.

Granitic rocks of the area have been classified as: la, Archean gray-phase Algoman granites; 1, Archean red-phase Algoman granites; 2, granitic rocks incorporated in Huronian conglomerates; 3, post-Huronian granitic intrusions. The red-phase granites, the Cutler granite, and Huronian boulders are characterized by simple malacon zircon, and the gray-phase granites by complex hyacinth. Contaminated granites contain mixtures of zircon types characteristic of the phases present. The growth trend for Cutler zircons is significantly different from the Algoman and indicates a magmatic origin. This study confirms that zircon studies are an effective tool in correlation and regional interpretation. Further work could be of great value in understanding Precambrian rocks.-ESL

01328 **Robertson, W. A.; Roy, J. L.; Park, J. K.** Magnetization of the Perry Formation of New Brunswick, and the rotation of Newfoundland-Reply to [discussion by] G. W. Pearce and G. N. Freda [1969, of 1965 paper]: Canadian Jour. Earth Sci., v. 6, no. 2, p. 356, 1969.

Pearce and Freda (ibid., p. 334-335) suggest that the BH2 site cannot be envisaged as made up of one main component which is the lone survivor after cleaning at 600°C, and of several other components oriented at random. The authors debate this statement, but otherwise agree. [Original paper, ibid., v. 5, p. 1075-1181, 1965.]-HRC

01246 **Robinson, Peter; Jaffe, Howard W.** Aluminous enclaves in gedrite-cordierite gneiss from southwestern New Hampshire: Am. Jour. Sci., v. 267, no. 3, p. 389-421, illus., tables, 1969.

Gedrite-cordierite gneisses interbedded with other mafic rocks from the Middle Ordovician Ammnoosuc Volcanics, of Richmond, N.H., contain aluminous enclaves in cordierite composed of kyanite, sillimanite, corundum, staurolite, spinel, and bytownite. Original gedrite-kyanite-sillimanite gneisses reacted to form cordierite so that remnant aluminosilicates are nowhere in contact with gedrite. Phase analysis using suggested equations suggests that the enclave assemblages resulted from continuous reactions which formed progressively more Fe-rich cordierite with changing P and T.-*from* Authors' abstract

**Robinson, Peter.** *See* Thompson, James B., Jr. 07242

07156 **Rockaway, John Dobbling, Jr.** Trend-surface analysis of ground water fluctuations [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 29, no. 3, p. 1065B, 1968.

07133 **Rodgers, John.** The eastern edge of the North American Continent during the Cambrian and Early Ordovician, Chap. 10 *in* Studies of Appalachian geology, northern and marine (Zen, E-an, and others, editors): New York and London, Interscience Publishers, p. 141-149, illus., 1968.

The boundary between the contrasting Cambro-Ordovician carbonate and clastic facies in eastern North America may have been an abrupt declivity similar to the margins of the present Bahama Banks. Two places where the edge of this early Paleozoic bank is possibly exposed are described; one is in northwestern Vermont and the other is in Lancaster County, Pa. The edge of the bank may record the eastern edge of the North American continent for that time.-JWC

07272 **Rodriguez, A. R.; Pirson, S. J.** The continuous dipmeter as a tool for studies in directional sedimentation and directional tectonics, *in* SPWLA Logging Symposium, 9th Ann., New Orleans, La., 1968, Trans: Houston, Tex., Soc. Prof. Well Log Analysts, p. G1-G25, illus., 1968.

It is known that a good correlation exists between petrofabric orientation and directional permeability and resistivity of rocks. It is also known that tectonic deformation of soft rocks, particularly of shales, gives rise to oriented secondary petrofabric and thereby to resistivity anisotropy. Accordingly, by using the oriented and focused resistivities (or conductivities) recorded by the three-arm dipmeter it is possible to derive the orientation in space of a resistivity anisotropy ellipse at selected and significant levels within the actual recorded dipmeter log and thereby derive the dominant directions of petrofabric orientation as controlled by sedimentation or by tectonic deformation processes.-Authors' abstract

01291 **Rogers, Donald P.** Fossil Basidiomycetes [discussion of "Fossil mycelium with clamp connections from the Middle Pennsylvanian" by R. L. Dennis, 1969]: Science, v. 164, no. 3880, p. 726, 1969.

The whole argument and conclusions of Martin (1945), cited by Dennis (ibid., v. 163, no. 3868, p. 670-671, 1969), are opposed to the statement for which they are quoted as support.-DBV

**Rogers, W. S.** *See* Spencer, R. S. 01370

01422 **Rogers, Wiley S.; Spencer, Randall S.** Sedimentary model for the Nansemond Formation (Pleistocene) southeastern Virginia [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 4, Southeastern Sec., p. 70-71, 1969.

01177 **Rohrer, W. L.; Obradovich, J. D.** Age and stratigraphic relations of the Tepee Trail and Wiggins Formations, northwestern Wyoming, *in* Geological Survey research 1969, Chap. B: U.S. Geol. Survey Prof. Paper 650-B, p. B57-B62, illus., 1969.

In the southern Absaroka Mountains the upper part of the Tepee Trail Formation interfingers with the lower part of the Wiggins Formation. This time-transgressive contact in the Pinnacle Buttes-Togwotee Pass area migrates stratigraphically upward toward the southeast. Potassium-argon ages of about 46 m.y. on hornblendes from andesites in the basal part of the Wiggins Formation at Pinnacle Buttes indicate a late middle Eocene age. A large flora from the lower part of the underlying Tepee Trail Formation indicates that the Tepee Trail at Pinnacle Buttes is middle Eocene.-Authors' abstract

01061 **Romer, Alfred Sherwood.** A temnospondylous labyrinthodont from the Lower Carboniferous: Kirtlandia, no. 6, 20 p., illus., 1969.

An amphibian skull and partial skeleton from the basal part [Bluefield Formation] of the Mauch Chunk Group of the Mississippian of West Virginia [at Greer, Monongalia County] is that of a colosteid temnospondyl described as *Greererpeton burkemorani* gen. et sp. nov.-Author's abstract

**Rose, Harry J., Jr.** *See* Lee, Donald E. 01174

01191 **Rose, Harry J., Jr.; Christian, Ralph P.; Lindsay, James R.; Larson, Richard R.** Microanalysis with the X-ray milliprobe, *in* Geological Survey research 1969, Chap. B: U.S. Geol. Survey Prof. Paper 650-B, p. B128-B135, illus., table, 1969.

The X-ray milliprobe, designed specifically for analysis of small selected areas generally 0.012 to 1.2 sq mm in size, using curved-crystal optics, can be used effectively for semiquantitative scanning of small grains, X-ray diffraction spindles, and selected areas within larger samples. It is particularly useful for quantitative analysis of small mineral samples. Various factors such as the shape and size of the aperture and sample mounting and preparation techniques, affect performance. Sensitivities obtainable are in the nanogram range as illustrated for iron, lanthanum, and calcium.-Authors' abstract

01243 **Rose, Robert L.** Some structural features of the Vallecitos-Butts Ranch syncline, San Benito County, California [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 3, Cordilleran Sec., p. 57, 1969.

01237 **Rosenfeld, John L.** Stress effects around quartz inclusions in almandine and the piezothermometry of coexisting aluminum silicates: Am. Jour. Sci., v. 267, no. 3, p. 317-351, illus., 1969.

Observations of piezobirefringent halos around approximately equatorial thin sections of equant quartz inclusions in almandine show that, under standard pressure and temperature, maximum relative compression at any point in the surrounding almandine is normally radial to such inclusions; the intensity depends upon geologic occurrence and increases with the acute angle $\Theta$ between *c* of quartz and the normal to the section. Observations in New England and the Alps generally support the modern hydrothermal determinations of the kyanite-sillimanite-andalusite triple point and are inconsistent with the older results obtained with opposed anvils. Combinations in the broad kyanite zones of the Chester dome, Vt., lie in the class in which halos are present for all values of $\Theta$.-*from* Author's abstract

07241 **Rosenfeld, John L.** Garnet rotations due to the major Paleozoic deformations in southeast Vermont, Chap. 14 *in* Studies of Appalachian geology, northern and marine (Zen, E-an, and others, editors): New York and London, Interscience Publishers, p. 185-202, illus., table, 1968.

In the area now occupied by the Chester and Athens domes in southeastern Vermont, two major phases of diastrophism are recorded in the Silurian and Devonian by rotated garnet. Event I is interpreted as a major subhorizontal flow westward before doming; it is also clearly connected with the large sigmoid isoclinal folds adjacent to the domes. The axes of rotation of event II depart widely from parallelism with those of event I. It is possible that event I is Acadian, and event II is Appalachian.-JWC

**Ross, G. J.** *See* Clark, J. S. 01216

**Rotenberg, A.** *See* Alterman, Z. S. 01380

01423 **Rowland, L. Orlando.** An application of geology to agriculture south of Lake Okeechobee, Florida [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 4, Southeastern Sec., p. 71, 1969.

**Rowland, Robert R.** *See* Valentine, James W. 01335

**Roy, J. L.** *See* Robertson, W. A. 01328

**Roy, Robert F.** *See* Birch, Francis. 07259

**Rubin, Meyer.** *See* Shacklette, Hansford T. 01182

**Rucker, Samuel J., 4th.** *See* McGreevy, Laurence J. 01312

**Rucklidge, J. C.** *See* Grasty, R. L. 01229

**Rucklidge, J. C.** *See* Elders, W. A. 01320

07148 **Russell, Donald Arthur.** Velocity-gradient relationships for water-saturated porous media [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 29, no. 3, p. 842B-843B, 1968.

01424 **Ryan, John J.; Goodell, H. G.** Rate of sediment accumulation in a modern estuary-Mobile Bay [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 4, Southeastern Sec., p. 71-72, 1969.

07308 **Sabine, P. A.** Observations on pyroclastic-flow deposits [abs.]: Geol. Soc. London Proc. 1968, no. 1649, p. 104-105, 1968.

01307 **Sainsbury, C. L.** Tin resources of the world: U.S. Geol. Survey Bull. 1301, 55 p., illus., tables, 1969.

Most tin of commerce is smelted from cassiterite, derived both from placer and lode deposits distributed widely over the world. Tin reserves of the free world, at a price between 2,000 and 3,080 dollars per long ton (2,240 lbs), are estimated to be at least 3,500,000 long tons in 1970; tin resources of lower grade are estimated to be at least 7,108,000 long tons. Tin reserves and resources of the U.S.S.R. and China together are estimated to be at least 2,130,000 and 4,260,000 long tons respectively. World reserves are ample to satisfy demand at a yearly production rate of 180,000 long tons of tin for about 31 years; resources should sustain production at a yearly rate of 200,000 long tons for an additional 56 years.-CLS

01425 **Sandberg, Philip A.; Moore, Michael C.; Stieglitz, Ronald D.; Worsley, Thomas R.** Relationship between ultrastructure and mineralogy in some cheilostome bryozoans [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 4, Southeastern Sec., p. 72-73, 1969.

07230 **Sass, J. H.; Killeen, P. G.; Mustonen, E. D.** Heat flow and surface radioactivity in the Quirke Lake Syncline near Elliot Lake, Ontario, Canada: Canadian Jour. Earth Sci., v. 5, no. 6, p. 1417-1428, illus., tables, 1968.

Heat flow was measured in 7 holes from 300 to 900 m deep. Values range from 1.20 to 1.40 with a mean of $1.32 \pm 0.02$ $\mu$cal/cm$^2$s, and no systematic variation was detected within the 50 km$^2$ area studied. Radiometric measurements show a downward (stratigraphically) concentration of Th, U, and K within the lower part of the syncline. Data yield an average rate of heat production of 4.5 heat generation units. Taking account of the ore zones, the heat production of the syncline is about 6 hgu, and corrections for structural effects and heat from the ore result in a value of 1.2 for the regional heat flow. This is within the range of other shield values, although somewhat larger than average for the Canadian shield.-*from* Authors' abstract

01382 **Savage, J. C.** Steketee's paradox: Seismol. Soc. America Bull., v. 59, no. 1, p. 381-384, illus., 1969.

Steketee noted that in a medium subject to invariable stresses at its boundaries, the introduction of a dislocation surface would always increase the strain energy of the medium. This has been misunderstood to imply that the introduction of a dislocation surface in that situation cannot represent rupture since rupture must be an energy-releasing process. It is shown here that the introduction of a dislocation surface can indeed cause a drop in mechanical energy if the entire system is considered. The proof is formulated in terms of internal strain which, of course, is the appropriate formulation of the earthquake problem.-Author's abstract

01255 **Saxena, S. K.** Analysis of equilibria involving garnet in rocks of granulite facies [discussion of paper by D. deWaard, 1965]: Am. Jour. Sci., v. 267, no. 4, p. 523-528, 1969.

Consideration of the possible reactions involving garnet and other mix crystals indicate that the existing mineral-chemical data are not enough to justify deWaard's (Jour. Petrology, v. 6, no. 1, p. 165-191, 1965; Am. Jour. Sci., v. 263, no. 5, p. 455-461, 1965) conclusions about the Adirondack region and the subdivision of the granulite facies.-Author's abstract

07283 **Schaller, Herman E.** Subsurface flow measurements in producing wells, *in* SPWLA Logging Symposium, 9th Ann., New Orleans, La., 1968, Trans.: Houston, Tex., Soc. Prof. Well Log Analysts, p. S1-S11, illus., 1968.

Analyzing the productivity of horizons once a well has started producing should be of great value. R/A tracers provide a wide range of applications in measuring fluid flow. Their application to identifying points of water entry and rates of water flow are described. Oil migration in the well bore is also documented by the use of R/A tracer. The positive identification and rate of oil movement at various depths in the well is accomplished by a sampling device that provides a continuous readout at the surface and which, through surface control, can take an unlimited number of readings on a single trip. This information is regularly obtained in pumping wells from tools run through the tubing-casing annulus. With the development of smaller O.D. survey tools this procedure should provide information that has been unavailable.-*from* Author's abstract

07315 **Scheidegger, A. E.** Microcanonical ensembles of river nets: Internat. Assoc. Sci. Hydrology Bull., v. 13, no. 4, p. 87-90, 1968.

It is shown that a thermodynamic analogy can be set up for structurally cyclic as well as for noncyclic river nets that satisfy Horton's law of stream numbers. In the latter case, the microcanonical formalism of statistical thermodynamics has to be used.-Author's abstract

**Scheidegger, A. E.** *See* Ranalli, G. 07317

**Schnabel, Robert W.** *See* Hatch, Norman L., Jr. 07131

**Schneider, Richard C.** *See* Matson, Roger M. 07260

**Schoellhamer, J. E.** *See* McCulloh, T. H. 07279

01245 **Schreyer, W.; Seifert, F.** Compatability relations of the aluminum silicates in the systems $MgO-Al_2O_3-SiO_2-H_2O$ and $K_2O-MgO-Al_2O_3-SiO_2-H_2O$ at high pressures: Am. Jour. Sci., v. 267, no. 3, p. 371-388, illus., tables, 1969.

Schreinmaker's analyses of phase relations in the pressure ranges 4 to 11 kb at various temperatures were undertaken, and three pressure-temperature grids constructed. In general at the highest pressures, kyanite and sillimanite were found to coexist, in the presence of free quartz, with the Mg-rich phases talc, gedrite, enstatite, and phlogopite. At lower pressures chlorite-quartz, yoderite-quartz, cordierite-yoderite, cordierite-corundum, cordierite-sapphirine, sapphirine-quartz, chlorite-muscovite, cordierite-muscovite, and cordierite-K feldspar occur. Therefore, Al silicate minerals should be most common in high-pressure metamorphic rocks of pelitic composition.-*from* Authors' abstract

01270 **Schreyer, W.; Seifert, F.** High-pressure phases in the system $MgO-Al_2O_3-SiO_2-H_2O$: Am. Jour. Sci., v. 267-A (Schairer Volume), p. 407-443, illus., tables, 1969.

At pressures between 8 and 30 kb and temperatures of 700 to 1200°C Mg-saturolite, yoderite, Mg-gedrite, pyrope, and a sapphirine ($Mg_2Al_4SiO_{10}$) were synthesized, as was a B-free kornerupine. The tentative stability fields of the compounds are outlined. The possible appearance of some of these phases in addition to, or instead of, pyrope, in rocks presumed to constitute the Earth's mantle, depends largely upon the compatibility relations in this system which, however, are only imperfectly known at present.-*from* Authors' abstract

01426 **Schubel, J. R.** Transport of suspended sediment in the upper reaches of the Chesapeake Bay [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 4, Southeastern Sec., p. 73, 1969.

**Schumann, H. H.** *See* Thomsen, B. W. 07338

07210 **Schwarz, E. J.** Thermomagnetic properties of banded manganiferous sediment from the Mid-Atlantic Ridge: Canadian Jour. Earth Sci., v. 5, no. 6, p. 1517-1518, illus., 1968.

Banded manganiferous sediment from the Mid-Atlantic Ridge is paramagnetic at 20°C and possibly has a Curie point at about -150°C. Heating of the sediment in the range 520-560°C prior to measuring probably results in the formation of a gradually changing ferrimagnetic spinel phase with a Curie point of 135°C, which increases up to 180°C. Heating to higher temperatures only results in a further increase in the relative abundance of the stable phase.-Author's abstract

01195 **Schweinfurth, Stanley P.** Contour finder-Inexpensive device for rapid, objective contouring, *in* Geological Survey research 1969, Chap. B: U.S. Geol. Survey Prof. Paper 650-B, p. B147-B148, illus., 1969.

A contour finder is described and illustrated that was designed to facilitate preparation of many structure contour maps based on data from a relatively large number of core holes. The finder is a simple, graphical, inexpensive instrument based on the principle of similar triangles, and can be used with any map scale and any amount of dip. It is equally useful for contouring based on any kind of relatively closely spaced data, as for example, magnetic, gravity or seismic survey data.-VSN

**Scott, J. C.** *See* Turner, J. D. 07141

**Scott, Jane V.** *See* Parker, Robert H. 01417

01420 **Scott, Robert B.** Chemical variations in fine dust interstitial to glass shards of ignimbrite cooling units [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 4, Southeastern Sec., p. 73, 1969.

**Scott, Ronald F.** *See* Ko, Hon-Yim. 01371

01540 **Sears, Charles E.** Geology and structure of the Blue Ridge Province along the New River, Grayson County, Virginia [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 4, Southeastern Sec., p. 74, 1969.

07202 **Seeland, David Arthur.** Paleocurrents of the late Precambrian to early Ordovician (basal Sauk) transgressive clastics of the western and northern United States with a review of the stratigraphy [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 29, no. 4, p. 1410B, 1968.

01171 **Segerstrom, Kenneth; Kirby, S. H.** Tuffaceous epiclastic breccia and sandstone near Hahns Peak, Colorado, and their genetic implications, *in* Geological Survey research 1969, Chap. B: U.S. Geol. Survey Prof. Paper 650-B, p. B19-B22, illus., 1969.

Tuffaceous epiclastic breccia and sandstone, of latest Miocene(?) to Pliocene age, that contain abundant large clasts of altered rhyolite porphyry crop out 1 mi west of Hahns Peak, Routt County, Colo. Clasts are identical lithologically with altered intrusive porphyry which crops out on Hahns Peak. This new evidence indicates that airborne clasts of porphyry, plus included fragments of Cretaceous shale, were erupted from a volcanic center at Hahns Peak and dropped into a small basin floored by Browns Park Formation of Miocene(?) age. Concurrently, coarse pyroclastic debris that fell on adjacent slopes was swept into the basin as very fluid lahars and was consolidated as epiclastic sediment. Eruption was halted by plugging of the vent, and extrusion was succeeded by intrusion, doming, and sulfide mineralization.-*from* Authors' abstract

**Seide, C.** *See* Yiou, F. 01311

**Seifert, F.** *See* Schreyer, W. 01245

**Seifert, F.** *See* Schreyer, W. 01270

01182 **Shacklette, Hansford T.; Rubin, Meyer.** Radiocarbon dating of ash deposits on Amchitka Island, Alaska, *in* Geological Survey research 1969, Chap. B: U.S. Geol. Survey Prof. Paper 650-B, p. B81-B83, illus., 1969.

Peat deposits on the tableland of Amchitka Island contain 3 layers of volcanic ash, each about 1-2 cm in thickness. Radiocarbon dates of discrete plant stems from these ash layers indicate that the age of the uppermost ash deposit is 725 ± 250 years B.P. The two lower ash layers lie about 7 cm apart; the average of their dates is 1,845 years B.P. The amount of peat above the ash layers indicates that average rates of accumulation are approximately 0.2 cm/yr for fibrous to mucky peat, and 0.052 cm/yr for the more completely humified and compacted peat (muck). The total depth of peat at this location (2.8 m) indicates that about 3,400 years was required for the formation of this deposit. It is estimated, therefore, that this tableland has borne a vegetation mantle no longer than 4,000 years.-Authors' abstract

01193 **Shapiro, Leonard.** Rapid determination of powder density of rocks by a sink-float technique, *in* Geological Survey research 1969, Chap. B: U.S. Geol. Survey Prof. Paper 650-B, p. B140-B142, tables, 1969.

Experiments indicate that finely crushed rock (<80 mesh) in a heavy liquid, if not agitated, sinks or floats as large aggregates of the constituent minerals rather than as discrete grains. The "average density" of the clumped crushed material closely approximates that of the rock powder and may be determined by a simple sink-float technique. Small samples of powdered rock are centrifuged in heavy liquids in a sequence designed to bracket density with narrow limits. Only about 100 mg of sample is required to obtain density determinations within ±0.04.-Author's abstract

01180 **Shawe, Daniel R.** Possible exploration targets for uranium deposits, south end of the Uravan mineral belt, Colorado-Utah, *in* Geological Survey research 1969, Chap. B: U.S. Geol. Survey Prof. Paper 650-B, p. B73-B76, illus., 1969.

Uranium deposits in Mesozoic sandstone at and near the south end of the Uravan mineral belt, Colorado-Utah, show a preferred association with zones of faults and folds. Many large deposits in Salt Wash Member of the Morrison Formation occur near faults associated with collapsed salt anticlines. Unexplored areas, where favorable strata may exist near faults, are on the northeast side of DisappointmentValley 5 mi east of Slick Rock, Colo., in a zone from Montezuma Canyon, Utah, to Dolores River Canyon, Colo. Deposits in Moss Back Member of the Chinle Formation are large and widespread along Lisbon Valley fault, Utah, and are related to a closed anticline. Another favorable area is a closed anticlinal structure near faults in the vicinity of Dolores River Canyon, 10 mi northeast of Dove Creek.-*from* Author's abstract

**Sheppard, Robert M.** *See* Greenfield, Roy J. 01378

07157 **Sheridan, Robert Edmund.** Seaward extension of the Canadian Appalachians [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 29, no. 3, p. 1065B, 1968.

01541 **Sherwood, W. Cullen.** Distribution of strontium in some recent and fossil Mercenaria [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 4, Southeastern Sec., p. 74, 1969.

01342 **Shieh, Y. N.; Taylor, H. P., Jr.** Oxygen and hydrogen isotope studies of contact metamorphism in the Santa Rosa Range, Nevada, and other areas: Contr. Mineralogy and Petrology, v. 20, no. 4, p. 306-356, illus., tables, 1969.

Aureoles in the Santa Rosa Range, Nev., and the Eldora area, Colo. are discussed; emphasis is on pelitic rocks. A consistent order of O-18/O-16 and D/H enrichment in coexisting minerals, and a correlation between isotopic fractionations among coexisting mineral pairs are commonly observed; the assemblages tend to approach isotopic equilibrium during contact metamorphism. Isotopic temperatures generally show good agreement with heat flow considerations. Temperatures are estimated to be 525 to 625°C at contacts of granitic stocks. Small-scale oxygen isotope exchange between intrusive and country rock is noted. The D/H ratios of biotite show geographic correlation similar to that shown by meteorite water. Contact metamorphic rocks do not

exchange large amounts of "igneous" $H_2O$ but regional metamorphic rocks appear to have done so.-*from* Authors' abstract

07300 **Shotwell, J. Arnold.** Miocene mammals of southeast Oregon: Oregon Univ. Mus. Nat. History Bull. 14, 67 p., illus., tables, 1968.

The late Miocene (Barstovian) Skull Springs fauna described here is the earliest of late Tertiary faunas of the northern Great Basin which are being studied in entirety to show interrelations of factors of faunal change. The Butte Creek volcanic sandstone in Red Basin, a previous collecting area, yielded 42 mammal species, about half insectivores and rodents; *Merychippus* and *Dromomeryx* were common large mammals. The equivalent Deer Butte Formation in Quartz Basin, a new collecting area, yielded 34 species, 21 insectivores and rodents, in a pond-bank association not previously known in the Barstovian. Specimens of large mammals are more numerous at Red Basin, small mammals at Quartz Basin. Only 9 species (4 insectivores and 4 rodents) are common to both faunules. These marked differences probably reflect synchronous diversity within the regional fauna.-VMJ

01294 **Shurbet, D. H.** A low-velocity layer in the Earth's crust: Geol. Soc. America Bull., v. 80, no. 5, p. 895-897, illus., 1969.

The P phase from earthquakes can be divided into two short-period parts; the Lg phase can be divided into two short-period parts and at least one longer period part. The short-period parts of both these phases have periods of less than one second on World Standard seismograms and the propagation is explained as a result of a low-velocity layer in the continental crust. This low-velocity layer is interrupted or modified in regions of mountain ranges, continental margins, and other crustal discontinuities.-Author's abstract

01542 **Sieburth, John McN.** Humic substances in estuarine waters [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 4, Southeastern Sec., p. 74-75, 1969.

**Sigafoos, R. S.** *See* Mullineaux, D. R. 01170

01184 **Sigafoos, Robert S.; Hendricks, E. L.** The time interval between stabilization of Alpine glacial deposits and establishment of tree seedlings, *in* Geological Survey research 1969, Chap. B: U.S. Geol. Survey Prof. Paper 650-B, p. B89-B93, illus., table, 1969.

Determining the age of the oldest tree growing on a recent deposit can be a reliable technique for estimating age of the deposit. The main source of error is the interval between stabilization of the deposit and germination of seedlings. Availability of seed, presence of a seedbed of fine-grained material, and a favorable climate are the principal controls. These conditions are met in valley bottoms at Mount Rainier, Wash., where tree ages were compared with known ages of recently deposited moraines; based on ages of more than 150 trees, the interval between sediment stabilization and seed germination is estimated to be 5 years for bottomland. Dating of a recently deposited pumice layer and ages of tree growing on an underlying moraine near timberline show that the interval is longer at high altitudes than at low.-*from* Authors' abstract

**Silberman, M. L.** *See* Chesterman, Charles W. 01240

01543 **Simmons, Henry B.** Some effects of man-made works in the hydraulic, salinity, and shoaling regimens on estuaries [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 4, Southeastern Sec., p. 75, 1969.

01544 **Simmons, W. B., Jr.; Radcliffe, D. R.** Composition of apatite from North Carolina and South Georgia phosphorites [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 4, Southeastern Sec., p. 75-76, 1969.

07173 **Simon, Ruth B.** Earthquake interpretations: Golden, Colo., Colorado School of Mines, unpaged, illus., tables, 1968.

Seismograms are arranged in order of increasing distance from the recording station of 25 km to 139°. Records are all from the stations at Bergen Park, Colo., and Palisades, N.Y. Comment about each earthquake is held to a minimum to encourage the student to note for himself the similarities, differences, and unusual features of each set of recordings. J-B traveltime tables have been used throughout; traveltime curves for surface focus and S-P times are included in the appendix. Earthquakes are included from similar distances but different azimuths, or from similar distances but different depths, for comparison.-*from* Author's introduction

01545 **Simpson, Dale R.** Precipitation of gypsum, brushite, and apatite [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 4, Southeastern Sec., p. 76, 1969.

07248 **Skehan, James W.** Fracture tectonics of southeastern New England as illustrated by the Wachusett-Marlborough Tunnel, east-central Massachusetts, Chap. 21 *in* Studies of Appalachian geology, northern and marine (Zen, E-an, and others, editors): New York and London, Interscience Publishers, p. 281-290, illus., table, 1968.

The rocks exposed in the Wachusett-Marlborough Tunnel are interpreted as a series of intensively deformed metamorphic rocks of probable Ordovician to Devonian or even Carboniferous age that dip generally northwest. Major structural features traversed by the tunnel are the Clinton fault zone, Boylston fault zone, and Rattlesnake Hill fault zone. Analysis of fault and joint data indicated that these fractures were produced by forces that had the same general direction during the entire history of their movement on westerly-dipping reverse faults.-JWC

**Skidmore, W. B.** *See* Pavlides, Louis. 07138

**Skymer, Thomas.** *See* Richards, Horace G. 01431

07316 **Smart, J. S.** Mean stream numbers and branching ratios for topologically random channel networks: Internat. Assoc. Sci. Hydrology Bull., v. 13, no. 4, p. 61-64, talbes, 1968.

Shreve's formulas for topologically random networks are used to calculate mean stream numbers and mean bifurcation ratios for particular values of $n_1$. The exact values are compared with the Monte Carlo results of Liao and Scheidegger.-Author's abstract

01205 **Smith, F. G.** Machine contouring of frequency in a three-variable closed array: Canadian Jour. Earth Sci., v. 6, no. 1, p. 187-190, illus., 1969.

A method is described for machine plotting of contour lines representing the frequency of occurrence of sample data points in a three-variable closed array. The frequency values are in units of standard normal deviation from the expected frequency of the same sample size of a random distribution. The program is written in FORTRAN IV for an IBM 7094 computer and a CALCOMP plotter under off-line magnetic tape control.-Author's abstract

**Smith, J. V.** *See* Chinner, G. A. 01275

01354 **Smith, J. V.** Magnesium pyroxene at high temperature-Inversion in clinoenstatite: Nature, v. 222, no. 5190, p. 256-257, tables, 1969.

This communication reinterprets the phase transformation occurring in clinoenstatite (Perrotta and Stephenson, 1965), thereby providing a general interpretation for all Mg-rich pyroxenes and, by implication, other rock-forming silicates. Careful comparison of the revised index for clinoenstatite, obtained from X-ray powder data, with those for low clinoenstatite and diopside shows that most of the stronger lines of all three patterns have common indexes. Further, a greater proportion of the possible lines for the new monoclinic cell are present than for the old triclinic cell. It seems reasonable that high clinoenstatite has space group C2/c, but single crystal data are needed. The stability of high clinoenstatite may be close to that of protoenstatite. Possibly only small differences of chemical substitution are required to interchange the relative stability.-DBV

**Smith, James W.** *See* Haney, Donald C. 01498

07280 **Smith, James Ward; Thomas, Harold E.; Trudell, Laurence G.** Geologic factors affecting density logs in oil shale, *in* SPWLA Logging Symposium, 9th Ann., New Orleans, La., 1968, Trans.: Houston, Tex., Soc. Prof. Well Log Analysts, p. P1-P17, illus., tables, 1968.

Two major geologic factors adversely affecting oil-yield estimations from density logs in Colorado's Green River Formation oil shale are examined. Crystalline nahcolite ($NaHCO_3$) and cavities left after nahcolite solution are seen by the density log as richer oil shale. Stratigraphic distribution of these geologic factors is described for the U.S. Bureau of Mines Colorado Corehole No. 2, and laboratory determinations of oil yield and rock density in the affected zone are compared with the density log. In nahcolite-bearing sections oil-yield estimation is feasible but with reduced accuracy. In the leached zone accuracy of oil-yield estimation is poor. The leached zone should be precisely located and calibrated separately.-Authors' abstract

07268 **Smith, W. E.; Clarke, O. M., Jr.; Zsabo, M. W.; Daniel, T. W., Jr.** Mineral resources, *in* Mineral and water resources of Barbour County, Alabama: Alabama Geol. Survey Inf. Ser. 37, p. 11-18, illus., 1968.

The principal minerals of economic importance in Barbour County are iron ore, bauxite, kaolin and other clays, sand and gravel, limestone, and lignite; volume estimates are based on available subsurface data and surface examination and sampling of outcrops; extent of potential deposits are shown on a map. Occurrence and properties are summarized.-GDC

01546 **Snipes, David S.** Metasomatism and granitization at Master's Kiln, Laurens County, South Carolina [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 4, Southeastern Sec., p. 77, 1969.

07287 **Snow, R. B.; Throop, W. H.; Williams, J. A.** Logging offshore wells in the United States, *in* SPWLA Logging Symposium, 9th Ann., New Orleans, La., 1968, Trans: Houston, Tex., Soc. Prof. Well Log Analysts, p. B1-B13, illus., 1968.

Some of the problems unique to offshore operations are discussed. For locations where the logging unit is on a floating vessel, special wave compensation devices are required to minimize the effects of motion between the logging unit and the borehole. Spurious signals on the S.P. curve are often difficult to eliminate. Cable measurement is more difficult because the logging units are stationed on the drilling rig and are only infrequently returned to land. A new high-speed data transmission system, using magnetic tapes and standard "voice" circuits, enables rapid delivery of logs to offices far from the wellsite. This system is also used to transmit the log data to computer centers, where computers merge and compute the data.-*from* Authors' abstract

07145 **Snyder, R. P.** Electric and caliper logs as lithologic indicators in volcanic rocks, Nevada Test Site, *in* Nevada Test Site: Geol. Soc. America Mem. 110, p. 117-124, illus., 1968.

Electric logs are used on Pahute Mesa at the Nevada Test Site for preliminary identification of volcanic rock units penetrated by drill holes. Induced and produced water in the drill holes have essentially the same resistivity, so the spontaneous potential curve is negated, and the resistivity curves measure pore space of the rock. Degree of welding or amount and kind of alteration affect pore space and, therefore, resistivity. In general, resistivities are lowest in bedded tuffs and increase proportional to welding in ash-flow tuffs, and are greatest in rhyolitic lava flows. Caliper logs locate lithologic zones which tend to slough or cave. These zones are poorly indurated ash-falls tuffs, vitric and highly fractured ash-flow tuffs and rhyolites. Zeolitized ash-flow and ash-fall tuffs and unfractured rhyolites are competent.-*from* Author's abstract

01370 **Spencer, R. S.; Rogers, W. S.** The Miocene-Pleistocene unconformity in Norfolk County, Virginia: Virginia Jour. Sci., v. 20, no. 1, p. 19-21, illus., table, 1969.

The Miocene-Pleistocene boundary in Norfolk County, Va., as exposed in a borrow pit near Deep Creek is a disconformity. The contact is emphasized by a 1 to 3-ft-thick layer of indurated limonitic sand, armored mudballs and well-rounded pebbles and cobbles of quartz, granite, gneiss and conglomerate. Both electric and drillers' logs were used to trace the disconformity in the subsurface. The overlying Pleistocene thickens rapidly to the east of a NW-SE line which is congruent with the eastern edge of the Dismal Swamp and the Southern Branch of the Elizabeth River. This eastward thickening is due to an increase in the dip of the Yorktown Formation of upper Miocene age.-Authors' abstract

**Spencer, Randall S.** *See* Rogers, Wiley S. 01422

**Spooner, E. L.** *See* Allen, R. H. 07169

01210 **Srivastava, Satish K.** New spinulose *Aquilapollenites* spp. from the Edmonton Formation (Maestrichtian), Alberta, Canada: Canadian Jour. Earth Sci., v. 6, no. 1, p. 133-144, illus., 1969.

Eighteen new species belonging to the genus *Aquilapollenites* are formally described from the Edmonton Formation (Maestrichtian), Alberta, Canada. All these species have reticulate sexine with spinules.-Author's abstract

**Stacey, J. S.** *See* Wilson, E. E. 01194

07233 **Stalker, A. MacS.** Geology of the terraces at Cochrane, Alberta: Canadian Jour. Earth Sci., v. 5, no. 6, p. 1455-1466, illus., table, 1968.

The Bow River terraces divide easily into an upper and lower set. The three terraces of the upper set are deltas built into lakes ponded in front of Laurentide ice, and are 15,000 to 19,000 years old. Erosion, resumed by the Bow River during the interstade, ceased during the ice readvance of about 12,000 years ago. Before the ice again retreated from the area, about 10,000 years ago, Bow River filled its valley with alluvium, and since then, the river has cut the lower terraces in the fill and the bedrock. The valley fill is the Bighill Creek Formation and is a prolific supplier of vertebrate fossils, most coming from a sand unit, the Clarke Pit Member. Radiocarbon dates show the member to be about 11,000 years old.-*from* Author's abstract

07340 **Stanley, Daniel J.; Drapeau, Georges; Cok, Anthony E.** Submerged terraces on the Nova Scotian shelf [with German and French summ.], *in* Coastal geomorphology: Zeitschr. Geomorphologie, supp. 7, p. 85-94, illus., 1968.

Glacial movements and variations in sea level have modified Pleistocene morphology and sediment distribution on the continental shelf off Nova Scotia. The presence of submarine terraces is a guide to the different stands of the sea. The terraces were cut by marine erosion along ancient shorelines at surf-base, with constancy of depth in relation to sea level. Observed terraces, between 25.6 and 159 m in depth, are concentrated where bathymetric relief is most accented; some buried by sediments were detected on seismic profiles. Two, at 121 and 146 m in depth, correspond to distinct periods of maximum glaciation. Close correlation between the Nova Scotia shelf terraces and those of the Atlantic shelf of the United States seems to verify the theory that the former have undergone no important tectonic modification since the end of Pleistocene.-GDC

**Stearns, Richard G.** *See* Wilson, Charles W., Jr. 01562

**Steller, D. L.** *See* Hoare, R. D. 01059

01314 **Stephens, D. R.; Louis, Hedley; Lilley, E. M.** Pressure-volume relationships for tuffs and rhyolites from the Nevada Test Site-UCRL-50578: Livermore, Calif., Lawrence Radiation Lab., Univ. California, 36 p., illus., tables, 1969.

The pressure-volume (PV) systematics of over 30 tuffs and rhyolites were examined to find a method of estimating PV data for unknown rock. When these rocks were divided into three classes (dry, vitreous; dry, crystalline; and saturated), PV data correlated reasonably well with initial densities of samples. Twenty-five tables of loading and unloading PV data are presented for rock of varying initial density for the three

classes; to estimate PV properties of a rock, only its initial density and appropriate class to which the sample belongs need be known. Physical significance of the correlation is discussed and limitations of techniques are described. The tables will be useful in estimating PV data in cases where calculations of a detonation must be made for a rock medium in absence of experimental data for the rock.-*from* Authors' abstract

01315 **Stephens, D. R.; Louis, Hedley; Lilley, E. M.** Loading-unloading PV curves for tuffs from the Nevada Test Site-UCRL-50554: Livermore, Calif., Lawrence Radiation Lab., Univ. California, 30 p., illus., tables, 1969.

The pressure-volume curves of ten tuffs from the Nevada Test Site were measured to 40 kbar at 22°C. Data for the water-saturated samples showed the phase transitions due to free water at about 10 and 22 kbar. Water freezes at 10 kbar, and transforms from pseudo-orthorhombic to the bcc structure at 22 kbar. However, the presence of "nonliquid" water, which is loosely contained within the lattice of clay or zeolitic minerals or adsorbed on particle surfaces, was also observed. The dry tuffs exhibited behavior typical of weak compressible rock. The bulk modulus is constant from 0 to 100 bars, followed by a very compressible region where voids are rapidly removed as a function of pressure. The bulk modulus does not approach its original value until pressures of 2 kbar or more are reached.-Authors' abstract

01401 **Stevenson, D. L.** Oil production from the Ste. Genevieve Limestone in the Exchange area, Marion County, Illinois: Illinois Geol. Survey Circ. 436, 23 p., illus., table, 1969.

The four townships making up the southeastern quarter of Marion County, Ill., contain seven relatively small oil pools. The major portion of the oil produced from these pools was trapped in oolitic limestones and sandstones of the Ste. Genevieve Formation. The oil appears to be accumulated in stratigraphic traps, as no significant structural closure is evident. A reconstruction of the geologic history of the area, aided by the technique of trend-surface fitting, suggests that structural folding was, however, an important factor in trapping the oil. Subsequent tilting of the area has removed the closure of the structures, but the oil did not escape because of permeability pinch outs of the reservoir beds.-Author's abstract

01272 **Stewart, D. B.; Ribbe, P. H.** Structural explanation for variations in cell parameters of alkali feldspar with Al/Si ordering: Am. Jour. Sci., v. 267-A (Schairer Volume), p. 444-462, illus., tables, 1969.

Low albite and maximum microcline are assumed to have completely ordered Al/Si distribution, and high albite and high sanidine are assumed to be completely disordered. Then relative position on the b-c plot of the point for the cell parameters of an alkali feldspar depends quantitatively on total Al in $T_1O$, and $T_1m$ (triclinic) or in the two $T_1$ (monoclinic) sites. The distribution of Al over the tetrahedral sites in the alkali feldspar of any structural state can be now estimated over a wide temperature range. The ordering process in K feldspars differs conceptually only in initial symmetry restraints; a single process is operative in both alkali feldspar end members.-*from* Authors' abstract

**Stieff, Lorin R.** *See* Hewett, D. F. 01183

**Stieglitz, Ronald D.** *See* Sandberg, Philip A. 01425

01547 **Stieglitz, Ronald D.; Watkins, Noel H.** Environmental and phylogenetic control of the chemical composition and fine structure of Gorgonian spicules from Bimini, Bahamas [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 4, Southeastern Sec., p. 77-78, 1969.

01548 **Stieglitz, Ronald D.; Wise, Sherwood W., Jr.** Observations of biogenic fine-grained carbonate particles by scanning electron microscopy [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 4, Southeastern Sec., p. 78, 1969.

07265 **Stoddard, John.** Brandon field, Kiowa County, Colorado, *in* Guidebook issue, southeastern Colorado: Mtn. Geologist, v. 5, no. 3, p. 139-152, illus., table, 1968.

Brandon field, first commercial Mississippian oil production in Colorado, was discovered in August 1965. Initial completion was made in carbonate rocks of the Osagean Series at a depth of 4,770 feet. The 24 producing wells drilled to date have established production also from the [overlying, top to bottom] St. Louis, Spergen and Warsaw Formations, covering a Mississippian stratigraphic interval of 300 feet. Petroleum is entrapped in a large anticlinal structure that shows evidence of early Paleozoic growth and is now located along the northeast trending Las Animas arch, generally considered to be a Laramide fold. Unique exploitation problems are caused by very low reservoir pressure, heterogeneous development of porosity and an extensive fracture system. Cumulative oil production through March 1968 was over 1,200,000 barrels.-*from* Author's abstract

07129 **Stone, Dwayne David.** Desmoinesian conodonts from Utah, Colorado, and Iowa [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 29, no. 4, p. 1410B-1411B, 1968.

**Stone, Jerome.** *See* Hewett, D. F. 01183

**Strock, H.** *See* Batterman, B. W. 01392

01077 **Stumm, Erwin C.** Devonian bioherms of the Michigan basin: Michigan Univ. Mus. Paleontology Contr., v. 22, no. 18, p. 241-247,illus., 1969.

The Devonian bioherms of the Michigan basin occur in an arcuate belt extending from Silica in northwestern Ohio, through a narrow belt in southwestern Ontario between Amherstburg and Formosa, and across the northern part of the lower peninsula of Michigan from Alpena to Petoskey. These bioherms are typically small and varied [in structure and fauna. They occur mainly in two stratigraphic zones: lower Middle Devonian Detroit River Group in Ontario, upper Middle Devonian Traverse Group in Michigan, and Silica Formation in Ohio.]-Author's abstract

**Stupnikova, N. I.** *See* Gerasimovskiy, V. I. 07328

07203 **Sutherland, Jeffrey Clark.** Mineral-water equilibrium, Great Lakes-Aluminosilicates [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 29, no. 4, p. 1411B, 1968.

**Sutton, Thomas C.** *See* Kopp, Otto C. 01413

01203 **Swanson, Donald A.** Lawsonite blueschist from north-central Oregon, *in* Geological Survey research 1969, Chap. B: U.S. Geol. Survey Prof. Paper 650-B, p. B8-B11, illus., 1969.

Lawsonite blueschist crops out in two windows of pre-Albian metamorphic rocks near Mitchell, north-central Oregon. It is associated with serpentine in one of the windows, and with chert, quartzite, crystalline limestone and marble, and mafic metavolcanic rocks in both windows. The blueschist strikes northeast and lies along the projected trend of similar rocks in the Klamath Mountains. The occurrence of the blueschist near Mitchell supports the suggestion by Warren Hamilton and W. B. Myers that the Klamath trend extends northeastward across Oregon and follows the late Paleozoic or Mesozoic continental margin.-Author's abstract

**Swanson, Frederick J.** *See* Clifton, H. Edward. 01308

01549 **Swift, Donald J.; Pirie, Gordon R.** Gulf of San Miguel, Panama-Reconnaissance of fine sediment dispersal by tidal currents in a tropical estuary [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 4, Southeastern Sec., p. 78-79, 1969.

07334 **Szabo, B. J.** Trace element content of plankton population from the Bahamas: Caribbean Jour. Sci., v. 8, nos. 3-4, p. 185-186, table, 1968.

Investigation of the radium and other alkaline earth element contents of mixed marine plankton samples, collected in the Bahamas between surface and 100 m depths, reveals a preference for radium and barium. The sequence of preferential uptake is: Ra>Ba>Sr>Ca>Mg. Analyzed spectrographically for transitional elements, the accuracy of the measurements (shown in a table) was estimated to be 10 percent. Decreasing concentrations of trace elements display the order: Fe>Zn>Cu>Ni>Mn. Vertical and areal variation of transition element concentrations are considerable. The titanium, iron and chromium contents in surface plankton were lower than those from deep water. The variation of trace constituents in plankton is presumably due to the occurrence of different species with affinity for certain transition elements.-GDC

01316 **Takasaki, K. J.; Hirashima, G. T.; Lubke, E. R.** Water resources of windward Oahu, Hawaii: U.S. Geol. Survey Water-Supply Paper 1894, 119 p., illus., tables, geol. map, 1969.

Outcropping rocks east of the volcanic Koolau Range are associated with caldera collapse and the main fissure dike complex and marginal dikes. The nearly parallel dikes retard movement of ground water through the rocks at an altitude of 1,000 feet in the rainy north and 400 feet near the south end. Permeability, high in the less weathered mountains, increases away from the dike complex. Ground-water storage, maximum 60,000 million gallons, has been reduced by development tunnels which break dike controls. Perennial streams form its principal discharge, which tunnels and wells divert; base flow of Kahaluu Stream, 2 1/2 miles from Haiku tunnel, was reduced by 26 percent. Chemical quality of water from the Koolau and Honolulu Volcanic Series is excellent; that near the coast and in calcareous materials may be contaminated by sea water.-GDC

01211 **Tanner, William F.** Surge flow-A model of the wall layer: Southeastern Geology, v. 10, no. 2, p. 93-110, illus., table, 1969.

Thin sheets of flowing water were studied, in nature and laboratory, on inclined surfaces of various materials. Flow was accompanied by surges (rain waves, slug flow, etc.) initially almost random but quickly regularized in geometry and speed by surface tension and other effects. Controlled variables were slope angle, discharge, surface roughness, surface tension, and viscosity. In flume studies, the very low shear ridges which appear under water on sand beds before individual grain motion is visible are thought to be caused by a wall layer equivalent of thin sheet surge flow. Initiation of sediment motion is a Froude phenomenon; once ripple marks have formed, continuation of sediment transport is a Reynolds phenomenon. Any of the several Froude regimes can form the sand surface markings preserved in the rock record.-VMJ

01550 **Tanner, William F.** Initiation of sand transport [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 4, Southeastern Sec., p. 79-80, 1969.

01551 **Tanner, William F.** Location of shear velocity [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 4, Southeastern Sec., p. 80, 1969.

01552 **Tanner, William F.** Ripple mark spacing vs fetch [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 4, Southeastern Sec., p. 81, 1969.

01215 **Taylor, F. C.; Dence, M. R.** A probable meteorite origin for Mistastin Lake, Labrador: Canadian Jour. Earth Sci., v. 6, no. 1, p. 39-45, illus., 1969.

Mistastin Lake, Labrador, lat. 55°53′ N., long. 63°18′ W., is a roughly circular lake with a large central island lying in a marked depression. A meteorite impact origin is indicated by shock metamorphism features and fracturing of anorthosite and adamellite on the central island and of inclusions in flat-lying igneous rocks on the western shore. The crater had an original diameter of about 20 km and an age, by whole-rock K-Ar determination, of 202±25 m.y.-Authors' abstract

**Taylor, H. P., Jr.** *See* Shieh, Y. N. 01342

01285 **Taylor, Thomas N.** Cycads-Evidence from the upper Pennsylvanian: Science, v. 164, no. 3877, p. 294-295, illus., 1969.

Fossil staminate cones of the order Cycadales collected from the upper Pennsylvanian Mattoon Formation in Lawrence County, Ill., extend the fossil record of true cycads from the Upper Triassic to the upper Pennsylvanian.-KAF

01217 **Tempelman-Kluit, Dirk J.** A re-examination of pseudoleucite from Spotted Fawn Creek, west-central Yukon: Canadian Jour. Earth Sci., v. 6, no. 1, p. 55-62, illus., tables, 1969.

New petrographic and chemical data for pseudoleucite from Spotted Fawn Creek and two new nearby localities in central Yukon Territory are presented and discussed in the light of recent experimental evidence on the origin of pseudoleucite. The petrologic, chemical, and experimental data suggest that natural pseudoleucite results from subsolidus breakdown of leucite under water pressure and that the space provided by this breakdown results in flux of the fluid phase that accomplishes partial removal of potash, enrichment in soda, and addition of water.-Author's abstract

01553 **Thayer, Paul A.** Depositional environments-Upper Triassic Dan River Group, North Carolina [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 4, Southeastern Sec., p. 81, 1969.

07179 **Theokritoff, George.** Cambrian biogeography and biostratigraphy in New England, Chap. 1 *in* Studies of Appalachian geology, northern and marine (Zen, E-an, and others, editors): New York and London, Interscience Publishers, p. 9-22, illus., 1968.

Strata of known Cambrian age crop out in New England and adjacent areas within two bands. A westerly band in the Hudson and Champlain valleys extends northward into southern Quebec; it has a sand-carbonate facies in its western part, grading eastward into a dominantly shale facies, part of which has been thrust westward onto the sand-carbonate facies to form the Taconic klippe. Sporadic outcrops along the coast in eastern Massachusetts, Maine, New Brunswick, and Nova Scotia constitute an easterly band dominated by the shale facies. During Early and Middle Cambrian, Pacific province faunas occupied sites on the shelf and adjacent parts of the basin, intermediate zone faunas on the outer margin of the shelf and, to a lesser extent, adjacent parts of the basin, and Acado-Baltic faunas around the islands in eastern Massachusetts.-*from* Author's abstract

**Thomas, Harold E.** *See* Smith, James Ward. 07280

**Thompson, James B., Jr.** *See* Zen, E-an. 07177

07242 **Thompson, James B., Jr.; Robinson, Peter; Clifford, Tom N.; Trask, Newell J., Jr.** Nappes and gneiss domes in west-central New England, Chap. 15 *in* Studies of Appalachian geology, northern and marine (Zen, E-an, and others, editors): New York and London, Interscience Publishers, p. 203-218, illus., geol. map, 1968.

Two belts of mantled gneiss domes extend through western New England parallel in general to the Connecticut River. This region is comprised of four distinct groups of Paleozoic crystalline rocks: (1) a sequence of metamorphosed sedimentary and volcanic rocks, (2) gneisses in the cores of the domes, (3) large semi-concordant plutonic sheets, and (4) discordant plutons. An early phase of deformation resulted in the development of several nappes; they were thrust from the east. This was followed by one or more phases of gneiss dome formation and related folding. The domes may mark the site of an ancient island arc.-JWC

07251 **Thompson, James B., Jr.; Norton, Stephen A.** Paleozoic regional metamorphism in New England and adjacent areas, Chap. 24 *in* Studies of Appalachian geology, northern and marine (Zen, E-an, and others, editors): New York and London, Interscience Publishers, p. 319-327, illus., tables, 1968.

Mineral zones in the metamorphic rocks of New England are shown on a map by isograds. The following zones are recognized: chlorite, biotite, garnet (almandite),

staurolite (kyanite only), staurolite (with andalusite), sillimanite, and sillimanite-potassium feldspar. The chemical reactions attendant on appearance of a higher rank mineral zone are given. The main period of regional metamorphism overlapped two or more major stages of deformation. In western New Hampshire and central Massachusetts there is evidence that isogradic surfaces are strongly overturned. The plutonic rocks of the New Hampshire Plutonic Series appear in most areas to be generally contemporaneous with, or slightly younger than, the main regional metamorphism.-JWC

**Thompson, Maxwell N.** *See* Pannella, Giorgio. 07325

07204 **Thoms, Richard Edwin.** Biostratigraphy of the Umpqua Formation, southwest Oregon [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 29, no. 4, p. 1411B-1412B, 1968.

07338 **Thomsen, B. W.; Schumann, H. H.** Water resources of the Sycamore Creek watershed, Maricopa County, Arizona: U.S. Geol. Survey Water-Supply Paper 1861, 53 p., illus., tables, geol. map, 1968.

Much of the streamflow here originates in mountainous areas and disappears quickly into adjacent alluvial deposits. Streamflow records from Sycamore Creek watershed show an average annual water yield of 6,110 ac-ft from the 165 sq mi of the upper hard-rock mountain area, where annual precipitation averages 20 inches. Only a small percentage reaches the Verde River as surface flow over the 9-mile reach of alluvial channel below the mountain front. Flows must be more than 200 cfs to reach the river; less than that they disappear into the lower alluvial area and are stored temporarily in the ground-water reservoir, and released as ground-water discharge to the Verde River at a constant rate of about 4,000 ac-ft per year. Evapotranspiration losses in the lower alluvial area, controlled by depth of water table, averaged 1,500 ac-ft per year.-*from* Authors' abstract

01249 **Thomson, Keith Stewart.** The environment and distribution of Paleozoic sarcopterygian fishes: Am. Jour. Sci., v. 267, no. 4, p. 457-464, illus., tables, 1969.

Although this group has been thought to have had a strictly fresh-water ancestry, there is considerable evidence that the ancestral stock was either marine or at least euryhaline. However, with the exception of the Coelacanthini, which generally persisted in more saline conditions, the later (Carboniferous and Permian) sarcopterygians are all fresh-water fishes. The over-all pattern of paleogeographic distribution of the Sarcopterygii is complex but offers considerable support for the theory that what are now the North American and Eurasian continents were closely adjoined in Paleozoic times.-*from* Author's abstract

07337 **Thomson, Keith Stewart; Vaughn, Peter Paul.** Vertebral structure in Rhipidistia (Osteichthyes, Crossopterygii) with description of a new Permian genus: Postilla, no. 127, 19 p., illus., 1968.

*Ectosteorhachis nitidus* from the Lower Permian of North America [Wichita Group, Texas] has holospondylous vertebrae, but a new North American genus of osteolepid rhipidistian of the same age [*Lohsania utahensis*, n.gen. n.sp., from the Halgaito Shale, San Juan County, Utah] has compound vertebrae each comprising a large principal and a small anterior median dorsal accessory centrum. Attempted embryological analysis of vertebral structure in Rhipidistia reveals no evidence of sclerotomic resegmentation and no direct homology with tetrapod vertebrae.-Authors' abstract

**Thomson, S.** *See* Broscoe, A. J. 01220

01351 **Thornbury, William D.** Principles of geomorphology (2d edition): New York and London, John Wiley and Sons, 594 p., illus., 1969; originally published 1954.

Although much of the original edition has been retained, numerous sections have been rewritten and considerable new material has been added; some old material has

been deleted. Chapters cover: backgrounds, fundamental concepts, process, weathering, soil processes, mass wasting, fluvial cycle and its complications, stream deposition, peneplain concept, topography on domal and folded and faulted structures, arid cycle, eolian land forms, karst topography, types and characteristics of glaciers, mountain glaciation, ice caps and topographic effects, coasts, topography of ocean floors, land forms resulting from volcanism, pseudovolcanic features, paleogeomorphology, and applied geomorphology.-MCM

**Throop, W. H.** *See* Snow, R. B. 07287

07274 **Timur, A.** An investigation of permeability, porosity, and residual water saturation relationships, *in* SPWLA Logging Symposium, 9th Ann., New Orleans, La., 1968, Trans: Houston, Tex., Soc. Prof. Well Log Analysts, p. J1-J18, illus., tables, 1968.

To establish a relationship for estimating permeability (K) of sandstones from in place measurements of porosity ($\Phi$) and residual fluid saturation ($S_{wr}$), measurements of K, $\Phi$, and $S_{wr}$ were made on 155 sandstones from 3 oil fields in North America. An empirical equation in terms of $\Phi$ and $S_{wr}$ was found to be a very good predictor of K for the poorly consolidated sandstones of the Gulf Coast field, whereas $\Phi$ was a slightly better predictor for the well-consolidated and relatively tight sandstones of the Colorado and California fields. Permeability of sandstones can be estimated with even greater accuracy from a combination of measurements of $\Phi$ and $S_{wr}$.-KAF

07275 **Timur, A.** Effective porosity and permeability of sandstones investigated through nuclear magnetic resonance principles, *in* SPWLA Logging Symposium, 9th Ann., New Orleans, La., 1968, Trans: Houston, Tex., Soc. Prof. Well Log Analysts, p. K1-K-18, illus., tables, 1968.

The laboratory measurements of porosity ($\Phi$), permeability (K), residual (irreducible) water saturation ($S_{wr}$), free fluid index (FFI), and spin-lattice relaxation time ($T_1$) were conducted on more than 150 sandstones from 3 different oil fields in North America. The results were analyzed to establish relationships for estimating effective porosity ($\Phi_e$) and permeability from in-place measurable quantities. The empirical relationship $\Phi_e = 1.4$ FFI - 3.2, was found to estimate $\Phi_e$ of sandstones within 2.9 porosity units from FFI, which is measurable with the nuclear magnetism log.-*from* Author's abstract

01554 **Toewe, E. Clayton; Conley, James F.** Statistical zircon correlation of some igneous rocks of the Martinsville West quadrangle, Virginia [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 4, Southeastern Sec., p. 82, 1969.

**Toksöz, M. Nefi.** *See* Boore, David M. 01360

**Toler, L. G.** *See* Musgrove, R. H. 07299

07171 **Tomikel, John.** Handbook of minerals: Pittsburgh, Pa., Allegheny Press, 133 p., illus., tables, 1968.

This handbook is designed as a tool for identification of minerals by observing their physical properties and as an inexpensive reference book for the collector and student of minerals. Sections of the book are: purpose and use of handbook; physical properties of minerals; chemical classes; mineral descriptions; tables-mineral hardness, color and luster, common element data, specific gravity; and places to look for minerals.-MCM

**Torum, Alf.** *See* Wilson, Basil W. 07332

01555 **Towe, Kenneth M.** Structure and calcification in some planktonic Foraminifera [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 4, Southeastern Sec., p. 82, 1969.

**Trask, Newell J., Jr.** *See* Thompson, James B., Jr. 07242

**Treichel, A.** *See* Gilliland, J. A. 07211

**Tremblay, L. P.** *See* Fraser, J. A. 01213

**Trudell, Laurence G.** *See* Smith, James Ward. 07280

07318 **Truesdell, Alfred H.** Activity coefficients of aqueous sodium chloride from 15° to 50°C measured with a glass electrode: Science, v. 161, no. 3844, p. 884-885, table, 1968.

Values of the mean activity coefficient of sodium chloride at 15°, 25°, 38°, and 50°C were determined for aqueous NaCl solutions of 0.01 to 1.0 molal from electromotive force measurements on the cell (sodium-sensitive glass electrode, aqueous sodium chloride, silver chloride-silver).-Author's abstract

01385 **Tsai, Yi-Ben; Aki, Keiiti.** Simultaneous determination of the seismic moment and attenuation of seismic surface waves: Seismol. Soc. America Bull., v. 59, no. 1, p. 275-287, illus., table, 1969.

A comprehensive spectral analysis of Love and Rayleigh waves was made on the Parkfield earthquake of June 28, 1966. A revised value of the seismic moment of the Parkfield earthquake is obtained. Revised attenuation coefficients indicate that Love waves have consistently higher dissipation than Rayleigh waves at periods 15 to 40 sec. Both show marked minimum of dissipation (Q over 800 for Love and over 1000 for Rayleigh waves) at periods between 20 and 25 sec. These Q data are consistent with a model which has a high-Q zone in the lower crust and uppermost mantle, overlying a low-Q zone which correlates well with the Gutenberg low-velocity zone.-*from* Authors' abstract

01556 **Tung, James Ping-ya.** Wall rock mineral assemblages, Calloway mine, Ducktown, Tennessee [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 4, Southeastern Sec., p. 82-83, 1969.

**Turcan, A. N., Jr.** *See* Winslow, A. G. 07142

07236 **Turek, A.; Peterman, Z. E.** Preliminary Rb-Sr geochronology of the Rice Lake-Beresford Lake area, southeastern Manitoba: Canadian Jour. Earth Sci., v. 5, no. 6, p. 1373-1380, illus., table, 1968.

Gold-quartz veins containing sericite and fuchsite were emplaced 2720 ± 185 m.y. ago. The mineralization postdates, and thus provides a minimum age for, the Rice Lake Group as well as for the successively younger basic intrusives, quartz diorite intrusives, and the San Antonio Formation. A whole-rock isochron for potassic granite to the north of the greenstones indicates an age of 2550±80 m.y., considered the age of the regional metamorphism. This is in agreement with an age of 2490 ± 90 m.y. registered for the Rice Lake Group phyllites. The rocks to the south of the greenstones are older than 2630 m.y., as determined by the cross-cutting of the pegmatites. The northern granites are not likely places for successful gold exploration.-*from* Authors' abstract

07141 **Turner, J. D.; Scott, J. C.; Newton, J. G.; Golden, H. G.; Avrett, J. R.** Water availability, Coffee County, Alabama: Alabama Geol. Survey Map 76, scale about 1 in. to 2 mi., section, separate text, 1968.

The major aquifer in Coffee County consists of the Clayton and Nanafalia Formations and the basal part of the Tuscahoma Sand. Because outcropping formations are not fully saturated, it is often necessary to drill to underlying aquifers to develop the water needed. Maximum depth needed to produce 350 gpm is about 800 feet in the central part of the county; water for industrial and municipal supplies can be obtained only from the major aquifer. Hardness and objectionable amounts of iron are problems locally, but for most uses water is generally satisfactory. Data tabulated in the text consists of records of drilled wells, geologic units and their water-bearing characteristics, partial chemical analyses of water from wells, and streamflow and chemical quality.-MCM

07215 **Twelker, Neil H.** Chief Joseph dam, *in* Assoc. Eng. Geologists, 1968 Natl. Mtg., Seattle, Wash., Guidebook to field trips: [Sacramento, Calif.] Assoc. Eng. Geologists, p. 14-17, illus., 1968.

Granodiorite bedrock underlies the left dam abutment and glacial material the right, although the entire foundation is upon the granodiorite. The surface material is impervious glacial till, and the leakage from the reservoir through the unconsolidated glacial material between the granodiorite and the till was a problem. Partial seepage control measures consisted on an upstream impervious blanket and a downstream drainage gallery and relief well system. Losses have declined to less than half the original amount since construction ten years ago.-HRC

07304 **Ulrych, T. J.** Oceanic basalt leads and the age of the Earth [reply to discussion, 1968, by V. M. Oversby, and G. W. Gast of 1967 paper]: Science, v. 162, no. 3856, p. 928, 1968.

The model on which the Concordia plot in Ulrych's paper (ibid., v. 153, no. 3798, p. 252-256, 1967) is based is a two-stage process. As the comment by Oversby and Gast (ibid., v. 162, p. 925-927) deals largely with the assumption made in reducing the general model to a two-stage process, the general model is presented here. It is the assumption that the U-238:Pb-204 ratio observed in the rock is representative of its source which was formed $t_1$ years ago (in other words, that $\mu_3=\mu_2$) which they challenge, but they examine the effect of this assumption by considering a specific case of mantle fractionation 2,000 m.y. ago which is not particularly relevant to the model. As for the Concordia plot, any method of plotting data acts as a filter on that data, and the Concordia filter achieves results that are not readily apparent from the lead ratio plot and in some cases has advantages over the latter.-DBV

01282 **U.S. Geological Survey.** Geological Survey research 1969, Chap. B: U.S. Geol. Survey Prof. Paper 650-B, p. B1-B201, illus., tables, 1969.

Scientific and economic results of current work by members of the Conservation, Geologic, and Water Resources Divisions are grouped under: (1) geologic studies-petrology and mineralogy, paleontology and stratigraphy, economic geology, sedimentation, geochronology, geochemistry, rock mechanics, geophysics, analytical methods, cartographic techniques; (2) hydrologic studies-ground water, surface water, relation between surface and ground water, quality of water, geochemistry of water, coastal geohydrology, and soil moisture. Subject and author indexes are included. Most papers are cited individually.-MCM

01335 **Valentine, James W.; Rowland, Robert R.** Pleistocene invertebrates from northwestern Baja California del Norte, Mexico: California Acad. Sci. Proc., 4th ser., v. 36, no. 17, p. 511-530, illus., tables, 1969.

Six fossil localities on marine terraces between the Tijuana Playas and Rosarito Beach have yielded 83 identified species of mollusks together with a few other invertebrate forms. The assemblages are small (43 molluscan species at the most diverse locality) but represent several distinctive environments: an exposed sandy shore or nearshore association; gravel shore or nearshore associations; and quiet-water lagoon or marine pond associations. Assemblages from elevations below about 100 feet include southern species and probably represent the Late Pleistocene Verdean Province. Assemblages from higher elevations, between 120 and 130 feet, do not include species that are sensitive biostratigraphic indicators within the Pleistocene.-Authors' abstract

07235 **vandeKamp, P. C.** Geochemistry and origin of metasediments in the Haliburton-Madoc area, southeastern Ontario: Canadian Jour. Earth Sci., v. 5, no. 6, p. 1337-1372, illus., tables, 1968.

The genesis of ortho- and para-amphibolites and related silicate and carbonate rocks in the Grenville province have been examined. X-ray fluorescence analysis for 31 elements in each of 100 rocks of similar types and of greenschist to granulite facies shows that the complex was originally tuffs and carbonates. Scapolite and clinopyroxene are dominant in many of the granulite-facies rocks, having developed from

decarbonated Ca-rich rocks to which Cl was added. Zinc and Pb were probably also added to the high-grade rocks. It is demonstrated that pelite-carbonate mixtures are unlikely progenitors of amphibolites but basic tuffs very likely are. Thin-layered amphibolites could easily be derived from the basic tuffs such as occur in unmetamorphosed sedimentary sequences.-*from* Author's abstract

**VandenBerg, A.** *See* Bukhari, S. A. 01292

**VanLoenen, Richard E.** *See* Lee, Donald E. 01174

**Vaughn, Peter Paul.** *See* Thomson, Keith Stewart. 07337

07162 **Vaux, Walter Gregson.** The motion and collection of suspended particles within streambed gravel [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 29, no. 3, p. 1015B, 1968.

01197 **Vecchioli, John; Carswell, Louis D.; Kasabach, Haif F.** Occurrence and movement of ground water in the Brunswick Shale at a site near Trenton, New Jersey, *in* Geological Survey research 1969, Chap. B: U.S. Geol. Survey Prof. Paper 650-B, p. B154-B157, illus., 1969.

Measurements of yield during drilling of 13 wells in the Brunswick Shale near Trenton, N.J., indicate that ground water occurs mainly in discrete zones controlled by bedding. Productivity of a well may depend on only one or on several zones; however, no relation was apparent between yield and number of zones penetrated. Movement of water under pumping and under natural conditions is preferentially along strike. Wells along strike and thus tapping common producing zones had greater drawdown than wells equidistant in transverse directions. Knowledge of a preferential direction of movement is invaluable when locating a well with respect to source of pollution or in attempting to minimize well interference.-*from* Authors' abstract

07216 **Vehrs, Robert.** A summary of the engineering geology of Grand Coulee dam and related features, *in* Assoc. Eng. Geologists, 1968 Natl. Mtg., Seattle, Wash., Guidebook to field trips: [Sacramento, Calif.] Assoc. Eng. Geologists, p. 18-26, illus., 1968.

The bedrock of the region and the foundation of the Grand Coulee dam is granite which contains three sets of joints, one vertical, one flat lying (probably from stress relief), and another dipping 5° to 15°. The bedrock is overlain by glacial till of varying thickness, in some cases over 100 feet thick, the total stratigraphic thickness being over 800 feet. Various problems encountered during the construction of the dam are described, the biggest one being the stabilization of the clays during excavation. Weathering or alteration of the granite foundation was not a major problem, most areas requiring only the removal of 3 to 10 feet of rock to reach unaltered material. The nearby glacial material was used extensively for the concrete needed in the dam.-HRC

01239 **Venkatarathnam, K.; McManus, Dean A.** Heavy minerals on continental shelf of northern Bering Sea [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 53, no. 2, p. 464, 1969.

**Viljoen, M. J.** *See* Anhaeusser, C. R. 07331

**Viljoen, R. P.** *See* Anhaeusser, C. R. 07331

01322 **Virgo, D.** Partitioning of sodium between coexisting K-feldspar and plagioclase from some metamorphic rocks: Jour. Geology, v. 77, no. 2, p. 173-182, illus., tables, 1969.

Fifty-nine K-feldspar-plagioclase pairs from eight areas of granulite facies and amphibolite facies metamorphic rocks were analyzed for $K_2O$, $Na_2O$, CaO, Ba, Sr, and Rb. The distribution of $NaAlSi_3O_8$ in these pairs is not regular, and cannot be corre-

lated with differences in either temperature or composition of the rock. Barth's two-feldspar geothermometer thus is believed to yield unreliable results. The partitioning of strontium in these feldspar pairs, however, is regular and a function of temperature. The failure of Barth's geothermometer may lie in local differences in temperature, nonequilibrium, differences in bulk composition, structural inversions, or other reasons.-FGB

01301 **Visher, Glenn S.** How to distinguish barrier bar and channel sands: World Oil, v. 168, no. 6, p. 106-108, 113, illus., 1969.

Six criteria for distinguishing barrier bar and channel sandstone deposits are briefly summarized and compared: geometry of sandstone body, vertical and lateral transitions, sedimentary structures, grain size, lithology, and SP-log shape. The author emphasizes vertical variations in textures and lithology, with related SP-log shape, as diagnostic criteria, and considers geometry alone to be the least significant criterion.-MWR

07160 **Vogt, Peter Richard.** A reconnaissance geophysical survey of the North, Norwegian, Greenland, Kara and Barents Seas and the Arctic Ocean [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 29, no. 3, p. 1110B-1111B, 1968.

**Volk, Richard W.** *See* Clair, Joseph R. 07261

01557 **Wagener, H. D.** Fusion and injection of granitic rocks in the east-central Piedmont of South Carolina [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 4, Southeastern Sec., p. 84, 1969.

07291 **Wagner, R. H.** Upper Westphalian and Stephanian species of *Alethopteris* from Europe, Asia Minor and North America [with Dutch abs.]: [Netherlands] Rijks Geol. Dienst Med., ser. C, v. 3, pt. 1, no. 6, 318 p., illus., 1968.

Thirty-three species and varieties, including 17 new, of fernlike foliage of the pteridosperm form-genus *Alethopteris* are treated monographically in a revision of elements of Upper Westphalian and Stephanian (upper Middle and Upper Pennsylvanian) floras of Europe, Asia Minor, and North America. Several forms originally recorded from North America by Lesquereux are redescribed and identified with elements of the European flora. Of the 33 taxa, two occur only in eastern and central North America (*A. pennsylvanica*, *A. robusta* var. *robusta*), and 10 others (including *A. missouriensis*, *A. sullivanti*) occur there as well as in the Old World. Classification within the family Alethopteridaceae and possible affinities among the species are discussed.-VMJ

07286 **Wallace, W. E.** Observations on the S.P. curve in general and offshore problems in particular, *in* SPWLA Logging Symposium, 9th Ann., New Orleans, La., 1968, Trans: Houston, Tex., Soc. Prof. Well Log Analysts, p. A1-A14, illus., 1968.

There are many "noises" and strong voltages associated with the offshore drilling rig and its environment which appear when logging the S.P. curve. A "remote ground" is the old tried and true solution and it still works. Noises are more noticeable when muds of low resistivity are used and often have greater values than the weak S.P. reflections. If it is uneconomic to change the salinity of the mud, the gamma ray curve is usually an acceptable substitute. The "down hole ground" often provides an on-the-job remedy when a long insulated wire for a remote ground is not available. It must be remembered that the S.P. will be distorted adjacent to casing, bottom of the hole, and any formation boundary involving thick stratigraphic units.-*from* Author's abstract

**Waller, Thomas R.** *See* Hazel, Joseph E. 01284

01558 **Wallick, E. I.** Liquid scintillation detection of low-level tritium in ground water of the Tallahassee, Florida area [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 4, Southeastern Sec., p. 84-85, 1969.

07271 **Walters, E. J.** Statistical study of neutron logs for correlation studies, *in* SPWLA Logging Symposium, 9th Ann., New Orleans, La., 1968, Trans: Houston, Tex., Soc. Prof. Well Log Analysts, p. F1-F15, illus., table, 1968.

A simple statistical method has been applied to neutron well logs to try to establish a bulk lateral equivalence between correlatable units across a field. The method used involves drawing distribution curves of the neutron values selected at regular intervals from each section of well logs to be correlated. Distribution curves can be used to simplify long sections of log, and yet preserve the sort of detail required by the geologist, log analyst, or reservoir engineer.-KAF

**Wanek, Alexander A.** *See* Callahan, James E. 01346

07222 **Ward, T. E.** Howard A. Hanson Dam, *in* Assoc. Eng. Geologists, 1968 Natl. Mtg., Seattle, Wash., Guidebook to field trips: [Sacramento, Calif.] Assoc. Eng. Geologists, p. 68-74, illus., 1968.

The dam is in the Eagle gorge section of the Columbia River. The gorge is eroded in Oligocene-Miocene volcanic rocks, the local bedrock being andesitic and basaltic flows, tuffs, and breccias cut by acidic and basic dikes and sills. Faulting, shearing, and hydrothermal alteration are also evident. The rock quality is highly variable. The development of the deeper rock valley resulted from Pleistocene events. An alluvium-filled abandoned channel is present and had to be considered in the design. Both the material in the abandoned channel and in the local glacial drift serve as aquifers to carry away reservoir water, and each must be watched.-HRC

**Warner, Jeffrey.** *See* Osberg, P. H. 07245

**Warnke, D. A.** *See* Brogden, W. B. 01407

**Warr, Jesse J., Jr.** *See* Overstreet, William C. 01069

01559 **Waskom, John D.** Petrology and gravity of the Lilesville granite batholith, North Carolina [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 4, Southeastern Sec., p. 85, 1969.

**Watkins, Noel H.** *See* Stieglitz, Ronald D. 01547

01560 **Weaver, J. L.** The phosphate industry-Past, present, future [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 4, Southeastern Sec., p. 86, 1969.

**Webster, D. S.** *See* Marine, I. W. 01443

01395 **Weiss, R. J.** Charge density and mometum density-A comparison between theory and experiment, *in* Accurate determination of X-ray intensities and structure factors, Internat. Mtg., Cambridge, England, 1968: Acta Cryst., v. A25, pt. 1, p. 248-256, illus., tables; discussion, p. 256-257, 1969.

X-ray structure factors and Compton line shape measurements give complementary information on charge and momentum density, the latter measurement evidencing greater sensitivity to valence electrons. Theoretical calculations of structure factors and Compton line shapes for solids have probable errors in excess of three percent. When these errors are compounded with experimental errors of several percent, cases for which comparison between theory and experiment is meaningful are limited to diamond, Si, Ge, MgO, LiH, Li, Be, Mg, Al and a few others. In diamond the 111 and 222 structure factors are in agreement with theory as are the 111 structure factors of LiH and MgO. Experimental momentum densities in Li, Be, Mg, and Al do not agree with conventional band calculations since these are unable to account for a significant electron-electron correlation effect.-*from* Author's abstract

**Wenk, H. R.** *See* Baker, D. W. 01321

07293 **Weyant, Marcel.** Ostracodes du genre *Poloniella* Gürich au Devonien moyen de l'île Ellesmere (Archipel Arctique Canadien): Rev. Micropaleontologie, v. 11, no. 2, p. 99l110, illus., tables, 1968.

A rich fauna of ostracodes of Couvinian age from the lower member of the Blue Fiord Formation, southwestern Ellesmere Island, Northwest Territories, has yielded four new species of the large, wide-ranging kloedenellid genus *Poloniella*: *sverdrupi*, *scheii*, *maclareni*, and *stefanssoni*. These species, here described, are grouped in a new subgenus, *Poloniella* (*Framella*), because they have certain characters in common that distinguish them from all other species presently assigned either to *Poloniella* or to *Dizygopleura* Ulrich and Bassler. Weyant proposes that *Dizygopleura* also should be considered a subgenus of *Poloniella*.-VMJ

01561 **Wheeler, Walter H.; Curran, H. Allen.** Confirmation of Cretaceous age of some indurated strata near Castle Hayne, North Carolina [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 4, Southeastern Sec., p. 86-87, 1969.

**White, E. J.** *See* Marchant, L. C. 07276

**White, Walter S.** *See* Zen, E-an. 07177

07178 **White, Walter S.** Marland Pratt Billings-An appreciation, *in* Studies of Appalachian geology, northern and marine (Zen, E-an, and others, editors): New York and London, Interscience Publishers, p. xi-xv, 1968.

The stratigraphy and structure of the Appalachians of New Hampshire were mapped, analyzed, and synthesized through long detailed field work by Marland Pratt Billings and his graduate students at Harvard University. Dr. Billings has also made substantial contributions in engineering, economic, and structural geology, and has exerted a strong influence in geological education. A bibliography of Billing's work to 1967 is included.-JWC

07205 **White, Willis Harkness.** Plutonic rocks of the southern Seven Devils Mountains, Idaho [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 29, no. 4, p. 1412B, 1968.

**Whitman, Robert V.** *See* Lambe, T. William. 01353

07137 **Whittington, H. B.** Zonation and correlation of Canadian and Early Mohawkian Series, Chap. 4 *in* Studies of Appalachian geology, northern and marine (Zen, E-an, and others, editors): New York and London, Interscience Publishers, p. 49-60, illus., tables, 1968.

The Canadian and Mohawkian Series of Newfoundland are comprised of contrasting carbonate and dark shale facies, the faunas being dominantly shelly and graptolitic, respectively. An autochthonous sequence includes the St. George and Table Head Formations, and a presumably allochthonous sequence embraces part of the Cow Head Group. The faunas of these stratigraphic units are described, and then correlations are made with terranes in Greenland, Spitsbergen, Ellesmere Land, western Ireland, Scotland, Norway, and other localities in Europe.-JWC

**Williams, Harold H.** *See* Harriss, Robert C. 01470

**Williams, J. A.** *See* Snow, R. B. 07287

01397 **Williams, John A.; Kartha, T. D. Krishna.** Model study of long-wave amplification by circular islands: Seismol. Soc. America Bull., v. 59, no. 1, p. 299-316, illus., tables, 1969.

The amplification of periodic gravity waves around circular cylinders and model islands composed of a circular seamount base and a cylindrical cap was studied in a ripple tank. The experimentally determined amplification factors for the cylinders agree with the predicted values of Havelock (1940) and are independent of the ratio of wavelength to water depth. The theory of Webster and Perry (1966) for the model

islands proved valid for long waves of length approximately equal to or longer than the island base diameter for an azimuth angle of O°. Homma's theory (1950) for the parabolic convex island was verified for long waves of length two-thirds the base diameter of the island for all azimuth angles.-*from* Authors' abstract

07237 **Williams, P. J.** Ice distribution in permafrost profiles: Canadian Jour. Earth Sci., v. 5, no. 6, p. 1381-1386, illus., table, 1968.

Soil samples from deep drill holes in permafrost have been analyzed with particular regard to lithology and ice occurrence. The occurrence of moisture accumulation and ice lensing was found to be compatible with predictions from air intrusion tests on the soil materials. Regard is paid to the special geomorphological conditions at the drill sites, and to recent findings in laboratory research on soil freezing.-Author's abstract

07332 **Wilson, Basil W.; Torum, Alf.** The tsunami of the Alaskan earthquake 1964-Engineering evaluation: U.S. Army Corps Engineers Coastal Eng. Research Center Tech. Memo. 25, [444] p., illus., tables, 1968.

The nature of earth dislocation is described and related to generation, propagation, and dispersion of the main tsunami waves. The complex tectonic movements pushed an initial wave 10 to 20 m high along a front of 650 km. Propagation of this wave is followed around the Pacific, and to Tierra del Fuego and Antarctica. Detailed studies are given of the main tsunami, and local seismic sea waves, for damaged areas. In addition to the wave analysis, an engineering evaluation for severely damaged areas is presented. Marigrams of component waves and oscillations for many places are included. The analyses relate tsunami waves to local bay and shelf oscillations, and to local tides. Separately paged appendices carry much of the data.-ESL

01562 **Wilson, Charles W., Jr.; Stearns, Richard G.** Lateral and vertical movements of rock in the Wells Creek structure, Tennessee [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 4, Southeastern Sec., p. 87, 1969.

01194 **Wilson, E. E.; Stacey, J. S.** A transistorized emission regulator for gas-source mass spectrometry, *in* Geological Survey research 1969, Chap. B: U.S. Geol. Survey Prof. Paper 650-B, p. B143-B146, illus., 1969.

A transistorized circuit is described for the precise control of electron emission from the filament in a gas-source mass spectrometer. The emission current can be adjusted up to 5 milliamperes, and its regulation is better than 0.005 percent for a 10-percent line-voltage change. Normal drift of the emission current is less than 0.002 percent per hour. The electron accelerating voltage can be adjusted up to a maximum of 150 volts with regulation of better than 0.01 percent for a 10-percent change in line voltage. This level of performance helps to ensure that fluctuations in the total ion beam in a mass spectrometer during the course of an analysis are kept below ± 0.1 percent.-Authors' abstract

07336 **Wilson, G. J.** Radius of curvature method for computing directional surveys, *in* SPWLA Logging Symposium, 9th Ann., New Orleans, La., 1968, Trans.: Houston, Tex., Soc. Prof. Well Log Analysts, p. D1-D11, illus., 1968.

Discrepancies inherent in the tangential method for computing directional surveys are reviewed. A radius of curvature method, in which curved well-bore segments are assumed, is presented. Basic mathematical expressions are derived and a computer routine is listed for computing directional surveys with the new method. Results of the two methods are compared in a typical situation. The radius of curvature method is indicated to be an improved procedure for performing calculations with the survey data obtained.-Author's abstract

07158 **Wilson, Richard Leland.** Systematics and faunal analysis of a Lower Pliocene vertebrate assemblage from Trego County, Kansas [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 29, no. 3, p. 1066B, 1968.

01324 **Windom, Herbert L.** Atmospheric dust records in permanent snowfields-Implications to marine sedimentation: Geol. Soc. America Bull., v. 80, no. 5, p. 761-782, illus., tables, 1969.

Mineralogy and size distribution of dust in permanent snowfields associated with the Antarctic and Greenland ice sheets and five temperate glaciers provide a means for distinguishing dust components derived from local sources from those derived from distant (global) sources. Accumulation rates of global dust determined by Pb-210 geochronology range from 0.1 to about 1.0 mm per $10^3$ years. Comparison of accumulation rate, mineralogy, and size distribution of globally transported dusts with those of adjacent marine sediments of the North and South Pacific and Central Atlantic oceans suggest that these areas may be receiving as much as 25 to 75 percent of their detritus from atmospheric dust fallout.-WHN

07142 **Winslow, A. G.; Hillier, D. E.; Turcan, A. N., Jr.** Saline ground water in Louisiana: U.S. Geol. Survey Hydrol. Inv. Atlas HA-310, 4 sheets, scale 1:750,000, text, 1968.

Although fresh water is abundant throughout most of Louisiana, some coastal areas and the extreme northwestern section have meager supplies. In general, salinity and temperature of saline water increase with depth; most saline water is of the sodium-chloride type. Sheet 1 contains maps showing approximate altitude of the 1,000 and 3,000 mg/l dissolved-solids surface, and a table of chemical analyses and related physical measurements of these slightly saline waters. The map on Sheet 2 shows approximate altitude of the 10,000 mg/l surface and tables for 3,000-10,000, 10,000-35,000, and more than 35,000 mg/l dissolved solids. Sheets 3 and 4 have maps showing estimated potential yield and aggregate sand thickness of the slightly saline water zone for 1,000-3,000 and 3,000-10,000 mg/l dissolved solids, respectively.-MCM

**Winston, Don.** *See* O'Connor, Michael P. 01416

**Winston, Don.** *See* Riggs, Stanley R. 01419

**Wise, Sherwood W., Jr.** *See* Stieglitz, Ronald D. 01548

01563 **Wise, Sherwood W., Jr.** Ultrastructure of the nacreous layer of pelecypods, gastropods, and cephalopods-A taxonomic comparison [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 4, Southeastern Sec., p. 87-88, 1969.

07161 **Witmer, Richard Everett.** Waveform analysis of geographic patterns recorded on visible and infrared imagery [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 29, no. 3, p. 1061B-1062B, 1968.

01271 **Woermann, E.; Brežny, B.; Muan, A.** Phase equilibria in the system MgO-iron oxide-$TiO_2$ in air: Am. Jour. Sci., v. 267-A (Schairer Volume), p. 463-479, illus., tables, 1969.

Spinel and geikielite melt incongruently at 1756° and 1630°C, respectively, whereas Mg-pseudobrookite melts congruently at 1662°C. The liquidus surface of the system MgO-iron oxide-$TiO_2$ shows large primary-phase areas of spinel and pseudobrookite solid solutions extending continuously across the diagram from the MgO-$TiO_2$ side to the iron oxide-$TiO_2$ side. In contrast to this, the primary phase areas of geikielite and hematite solid solutions are restricted to areas adjacent to the two bounding systems MgO-$TiO_2$ and iron oxide-$TiO_2$ at liquidus temperatures in air. In central part of the system, the rhombohedral phases are unstable relative to the phase assemblage spinel plus pseudobrookite.-*from* Authors' abstract

**Wolf, Robert C.** *See* Bolyard, Dudley W. 07267

**Wones, D. R.** *See* Gilbert, M. C. 01494

01279 **Wones, David R.; Gilbert, M. Charles.** The fayalite-magnetite-quartz assemblage between 600° and 800°C: Am. Jour. Sci., v. 267-A (Schairer Volume), p. 480-488, illus., tables, 1969.

The $f_{oxygen}$-T° curve for the assemblage fayalite-magnetite-quartz has been determined between 600° and 800°C by means of hydrothermal experiments in which temperature, total pressure, and hydrogen pressure are the independent variables. Combining these new data with that of certain earlier high-temperature investigations, the oxygen fugacity of the assemblage at 1 bar over the range 600° to 1100°C can be described by $\log f_{oxygen} = (-25{,}738/T) + 9.00\ (\pm 0.10)$. The determined equilibrium is in reasonable agreement with the available thermochemical data.-Authors' abstract

01564 **Wood, E. J. Ferguson.** The ecology of bacteria in estuarine systems [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 4, Southeastern Sec., p. 88-89, 1969.

**Wood, J.** *See* Chandler, F. W. 01228

01565 **Wood, James; Bricker, Owen P.** A chemical equilibria model of an estuarine environment [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 4, Southeastern Sec., p. 89, 1969.

**Wood, Patricia W.** *See* Nicholson, Alex. 01355

**Woodburne, Michael O.** *See* Jepsen, Glenn L. 01289

01365 **Woodward, Lee A.** Comparative tectonics in petroleum exploration: Oil and Gas Jour., v. 67, no. 17, p. 106-111, illus., 1969.

Comparison of major tectonic features in western United States shows that each feature has a structural or tectonic style that directly controls petroleum accumulation or nonaccumulation. Similarities and differences in tectonic style are considered in evaluating the petroleum potential of various structural provinces.-HHA

**Worsley, Thomas R.** *See* Sandberg, Philip A. 01425

**Wright, A. C.** *See* Crippen, R. G. 07335

**Wright, R. C.** *See* Bandy, O. L. 01287

01266 **Wyllie, P. J.; Boettcher, A. L.** Liquidus phase relationships in the system $CaO$-$CO_2$-$H_2O$ to 40 kilobars pressure with petrological implications: Am. Jour. Sci., v. 267-A (Schairer Volume), p. 489-508, illus., tables, 1969.

Melting reactions of $CaCO_3 + Ca(OH)_2$ = liquid and $CaCO_3 + Ca(OH)_2$ + vapor = liquid, have been extended from 4 kb to 40 kb. Points measured for reaction (1) are: 655°C at 4 kb, 659°C at 15.5 kb, 662°C at 25 kb and 666°C at 40.7 kb, and for reaction (2) 630°C at 4 kb, 565°C at 15.5 kb, 537°C at 25 kb and 524°C at 40.8 kb. A pressure-temperature projection for the system $CaO$-$CO_2$-$H_2O$ is presented, in part schematic, from 300°C to 1500°C and from 1 bar to 40 kb. The carbonate phase changes from calcite to aragonite with increasing pressure. Textures observed in quenched liquids are compared with textures described in carbonatites and adduced as evidence supporting a magmatic origin for these carbonatites.-*from* Authors' abstract

**Wyllie, P. J.** *See* Gibbon, D. L. 01323

01281 **Yagi, Kenzo; Onuma, Kosuke.** An experimental study on the role of titanium in alkalic basalts in light of the system diopside-akermanite-nepheline-$CaTiAl_2O_6$: Am. Jour. Sci., v. 267-A (Schairer Volume), p. 509-549, illus., tables, 1969.

Liquidus and subsolidus results obtained on 197 compositions on bounding planes of the tetrahedron and along four sections parallel to the basal plane, diopside-akermanite-nepheline revealed six-phase assemblages: forsterite + melilite + nepheline$_{ss}$ + spinel + perovskite + liquid; forsterite + melilite + spinel + perovskite + diopside$_{ss}$ + liquid; diopside$_{ss}$ + forsterite + melilite + nepheline$_{ss}$ + perovskite + liquid; diopside$_{ss}$ + melilite + nepheline$_{ss}$ + perovskite + corundum + liquid. Crystallization differentiation in this system is applicable to melilite-bearing subsilicic, alkalic magmas. The inferred trend of differentiation is olivine melilitite →

olivine melilite nephelinite → perovskite-bearing melilite nephelinite → corundum-bearing melilite nephelinite.—*from* Authors' abstract

01265 **Yamamoto, H.; Kennedy, G. C.** Stability relations in the system $CaSO_4$-$H_2O$ at high temperatures and pressures: Am. Jour. Sci., v. 267-A (Schairer Volume), p. 550-557, illus., table, 1969.

Phase equilibria in the system $CaSO_4$-$H_2O$ were investigated at water pressures up to 30 kb. The following reactions have been studied: $CaSO_4 \times H_2O = CaSO_4 \times 0.5H_2O + 1.5H_2O$; and $CaSO_4 \times 0.5H_2O = CaSO_4 + 0.5H_2O$. The second curve intersects the first curve at an invariant point located at approximately 85°C and 2 kb. Below this pressure calcium sulfate hemihydrate does not exist as a stable phase. The location of the stability of bassanite in the P-T field suggests that bassanite is metastable in the reported natural occurrence.-Authors' abstract

07184 **Yang, Tsung.** Sand dispersion in a laboratory flume [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 29, no. 4, p. 1369B, 1968.

01361 **Yao, Kuan M.** Deposition of suspended particles in a gravel bed-Discussion [of paper 6102 by H. A. Einstein, 1968]: Am. Soc. Civil Engineers Proc., v. 95, paper 6433, Jour. Hydraulics Div., no. HY 2, p. 761-762, 1969.

The statement (ibid., v. 94, no. HY 5, p. 1197-1205) that no effect of surface forces was shown can be misleading. These forces can bring suspended particles together causing flocculation, or they can prevent them from approaching each other; which way they work depends on surface properties of the particles. Surface forces could have played an important role in the process described. Two possible reasons for deposition of suspended particles on the bottom rather than on the surface of the gravels are given.-ESL

01309 **Yeend, Warren E.** Quaternary geology of the Grand and Battlement Mesas area, Colorado: U.S. Geol. Survey Prof. Paper 617, 50 p., illus., tables, geol. map, 1969.

An ice cap covered most of the surface of Grand Mesa at least twice during the late Pleistocene and fed active glaciers in the surrounding deeply incised valleys. Glaciers extended to a probable minimum elevation of 5,400 feet. Battlement Mesa, lacking evidence of Pleistocene glaciation, has been markedly modified by mass wasting processes. This report describes the glacial, alluvial, and colluvial deposits and discusses the geologic history of the area. A colored geologic map (scale 1:96,000) covering approximately 1,000 sq mi shows the distribution of 25 different Quaternary deposits.-WEY

07163 **Yegulalp, Tuncel Mustafa.** A decision making problem in mineral exploration [abs.]: Dissert. Abs., Sec. B, Sci. and Eng., v. 29, no. 3, p. 1038B, 1968.

01311 **Yiou, F.; Seide, C.; Bernas, R.** Formation cross sections of lithium, beryllium, and boron isotopes produced by the spallation of oxygen by high-energy protons: Jour. Geophys. Research, v. 74, no. 9, p. 2447-2448, table, 1969.

All available information on the production of Li, Be, and B isotopes from O-16, including some new information, are tabulated. Some implications of these results in astrophysics and cosmic ray physics have already been published. In particular, a new value of $5.4 \pm 1$ g per cm² has been obtained for the quantity of matter traversed by galactic cosmic rays of energies greater than 1.5 Gev per nucleon; this is higher than the 3 g per cm² generally accepted until now. Also, inasmuch as O-16 can be considered a representative target, the stability of Be-7 in galactic cosmic rays is a direct consequence of the comparison between cosmic ray measurements and the results given here.-DBV

01269 **Yoder, H. S., Jr.; Kushiro, I.** Melting of a hydrous phase-Phlogopite: Am. Jour. Sci., v. 267-A (Schairer Volume), p. 558-582, illus., table, 1969.

The upper stability limit of phlogopite has been studied up to 37.5 kb under both gas-present and gas-absent conditions. The stability field is greatly expanded in the gas-absent region. Melting of phlogopite in this region is analogous to the partial melting of a hydrous parental assemblage in the mantle or lower crust. The highly alkaline character and $H_2O$ content of the liquids in equilibrium with phlogopite, the incongruent melting relationship of the phlogopite to forsterite and liquid, and the high-pressure and high-temperature stability of phlogopite have important bearing on the origin of kimberlite.-*from* Authors' abstract

**Young, G. M.** *See* Chandler, F. W. 01228

01402 **Young, R. A.** Present problems and future opportunities in precise intensity measurements with single-crystal X-ray diffractometers, *in* Accurate determination of X-ray intensities and structure factors, Internat. Mtg., Cambridge, England, 1968: Acta Cryst., v. A25, pt. 1, p. 55-66, illus., table, 1969.

Considerable progress is foreseen toward the precise determination of integrated X-ray reflection intensities from small single crystals. High on the list of presently-limiting problems are multiple reflection, extinction, thermal diffuse scattering, unnecessary other background, counting statistics, effective integration and specimen change. Specific recommendations for equipment design and use are made which will partially alleviate each of them. Opportunities for better utilization of existing equipment through improved strategies for data collection and employment of small on-line computers are pointed out.-Author's abstract

01356 **Zachariasen, W. H.** Theoretical corrections for extinction, *in* Accurate determination of X-ray intensities and structure factors, Internat. Mtg., Cambridge, England, 1968: Acta Cryst., v. A25, pt. 1, p. 102, table, 1969.

A theoretical extinction correction for structure factors is given.-Author's abstract

01235 **Zen, E-an.** The stability relations of the polymorphs of aluminum silicate-A survey and some comments: Am. Jour. Sci., v. 267, no. 3, p. 297-309, illus., tables, 1969.

Existing determinations of the P-T relations of sillimanite, kyanite, and andalusite show large discrepancies in the locations of univariant lines and of the invariant point, probably resulting partly from determination of synthesis rather than stability fields and partly from experimental difficulties in pressure determinations. These do not account for all of the observed spread, and possible effects of compositional variations cannot be excluded. The rapidly grown fine-grained sillimanites have not been verified as to their stoichiometry and the crystal-chemical ordering of the cations. Lack of such compositional and/or structural perfection in the synthetic crystals as has been ascertained for coarse natural samples could profoundly affect the location of the stability fields of these aluminum silicate polymorphs.-*from* Author's abstract

07132 **Zen, E-an.** Nature of the Ordovician orogeny in the Taconic area, Chap. 9 *in* Studies of Appalachian geology, northern and marine (Zen, E-an, and others, editors): New York and London, Interscience Publishers, p. 129-139, illus., 1968.

The Taconic section is comprised of Cambrian(?), Cambrian, Lower Ordovician, and Middle Ordovician shales and graywackes; it is partly autochthonous and partly allochthonous. The autochthonous units are post-Lower Ordovician and are restricted to the southern and western peripheral areas of the Taconic terrane. The allochthonous mass is divisible into six structurally distinct thrust slices. Emplacement of the two lowest is dated as late Trenton, whereas the highest was emplaced before onset of the main phase of the Acadian orogeny and is assigned tentatively to the end of the Middle Ordovician. It is possible that the main phase of the Taconic orogeny elsewhere in the Appalachian belt may prove to be unrelated to the diastrophism that has affected the Taconic rocks.-JWC

07177 **Zen, E-an; White, Walter S.; Hadley, Jarvis B.; Thompson, James B., Jr.** (editors). Studies of Appalachian geology, northern and marine: New York and London, Interscience Publishers, 475 p., illus., tables, geol. map, 1968.

This collection of thirty-three papers, dedicated to Marland Pratt Billings, reviews comprehensively the stratigraphy and structure of the Northern Appalachians. Each article is cited separately.-JWC

01333 **Zietz, Isidore; Hearn, Carter.** Interpretation of eastern Montana geophysical surveys [abs.]: EOS (Am. Geophys. Union Trans.), v. 50, no. 4, p. 320, 1969.

07296 **Zonneveld, J. I. S.** Quaternary climatic changes in the Caribbean and N. South America: Eiszeitalter u. Gegenwart, v. 19, p. 203-208, 1968.

This paper summarizes available data on climatic changes in the Caribbean and northern South America. In Colombia, northwestern Venezuela, the Leeward Islands, and Barbados, the pluvial periods coincided with the glacial periods at higher latitudes. The evidence for Guiana and Surinam is sufficient to establish the climatic evolution, but the climate seems to have been less humid during the glacial periods than at present, which would correspond to a 10° shift in the arid belt.-DBV

**Zsabo, M. W.** *See* Smith, W. E. 07268

01331 **Zullo, Victor A.** A late Pleistocene marine invertebrate fauna from Bandon, Oregon: California Acad. Sci. Proc., 4th ser., v. 36, no. 12, p. 347-361, illus., tables, 1969.

Fossiliferous material collected from the Bandon marine terrace deposit at the Grave Point locality has yielded at least 59 invertebrate taxa, including 21 gastropods, 12 pelecypods, 4 chitons, 8 cirripeds, 4 malacostracans (decapods), 3 foraminifers, 2 bryozoans, 2 echinoids, 2 brachiopods, and one ahermatypic coral; at least 37 invertebrates, including 7 not recorded from Grave Point, were identified from nearby Coquille Point. Locally, abundance, and habitat (exposure, substratum, tide level) preferred by extant counterparts, are tabulated for each species. These data indicate that the Bandon fauna was derived predominantly from the lower intertidal and subtidal reaches of a rocky coast that was protected from surf; it resembles the present fauna of Puget Sound.-VMJ

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